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Plate 1. *THUYA ORIENTALIS* Linnaeus

CHINESE ECONOMIC TREES

By

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ILLUSTRATED WITH 100 PLATES

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PREFACE

So far as the author is aware, this is the first book on the common, important Chinese trees that has been written in any language. Although the literature of Chinese flora is rather extensive, it is scattered through numerous publications, issued in many different languages, and as few of the standard botanical works are available in China, it has been next to impossible to identify even the commoner plants around us. This manual aims to fill, in a measure, the need that has been felt for some time for a handy volume on Chinese trees. With the help of this book, even those with only a meager knowledge of botany will be able to identify a large number of the trees likely to be encountered, and at the same time to learn something of their characteristics and uses in so far as these are known. This manual is also designed as a textbook for use in Middle Schools and Colleges, particularly in the institutions where agricultural sciences are emphasized. The manuscript has been subjected to actual test of the classroom, during the past year, at the College of Agriculture and Forestry of the University of Nanking.

Obviously, in a work of this scope, it is impossible to describe every arborescent species found in this country. Only a small proportion of the species of Chinese trees are here described. A more comprehensive work remains for development in the future. The limits of the present volume admit the description, in most cases, of only one or two representative species in each genus and a bare enumeration of others of minor importance. On this account, the family and generic characters are given in some detail, in order to enable students to place a tree not treated in this work at least in the proper family and genus. It will be noted that following the description of families of more than one genus, there is a key to the genera, but following the description of the genus there is no key to the species. This omission is justified by two considerations. In the first place, the number of species is not sufficiently inclusive to render a key of any considerable value, and, in the second place, in the instances where the species treated under any one genus are sufficiently comprehensive, as under the oaks, an opportunity is given the students to acquire practice in making keys themselves.

Throughout this book, the specific names of the plants are uniformly written without capitals in accordance with the procedure prevailing in zoölogy, and with some progressive botanists, as those of the United States National Herbarium, but contrary to the rule of nomenclature

adopted by botanists at the Vienna Congress. In ordinary botanical nomenclature, the specific name when derived from a person must be capitalized as a special mark of honor to the person whose name the plant bears. The introduction of this extraneous element into the name of a plant serves no legitimate purpose, but rather adds confusion and complexity. For the sake of clarity and simplicity, it seems best to disregard a useless rule. It is hoped that the younger botanists in China, collectively, will have sufficient independence to introduce the change which is manifestly advantageous, and which will, undoubtedly, become the universal practice of the future.

The author has taken considerable pains to eliminate inaccuracies as far as possible, but no doubt, many defects and errors have been overlooked, and any one who points them out or who is willing to communicate additional notes and information on the range, habits, and uses of any of the trees will not only earn the gratitude of the author but at the same time advance the status of Chinese dendrology.

The material for this book was compiled at the Arnold Arboretum of Harvard University in the United States of America. To the Director of the Arnold Arboretum, Professor C. S. Sargent, the author offers his sincere thanks for placing the splendid facilities of that institution at his disposal. The Arboretum contains a remarkable collection of the hardy Chinese trees and shrubs adapted to a northern climate, as well as an herbarium of Chinese woody plants which is, perhaps, unsurpassed by that of any other institution in the world. The descriptions of the trees in this work are based, in nearly every case, on the original Latin or other description, supplemented by notes by various authors (particularly those of Mr. E. H. Wilson), and by comparison with herbarium material and studies of living trees. The drawings were made from herbarium specimens and from living plants when obtainable, except a few that were redrawn from published works, in which case, the source is indicated on the plates.

The author is greatly indebted to Miss Mary I. Bash, formerly of Seattle, Washington, and to Mr. Goey Park Jung, Professor of Entomology of the Government Southeastern University at Nanking, for help with the inking of some of the drawings. Finally the author must acknowledge a great debt of gratitude to his former teacher, Professor J. G. Jack of Harvard University. Without his suggestions this book, crude as it is, would not have been written. It must be understood, the author is alone responsible for the views therein expressed.

Shanghai, August 22nd, 1921.

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(Illustrations half life size)

SYNOPSIS OF ORDERS AND FAMILIES TREATED IN THIS WORK

CLASS I GYMNOSPERMAE

Ovules naked, borne on the face of a scale, not inclosed in an ovary.

ORDER GINKGOALES

Stems with branches; secondary wood without vessels. Flowers unisexual, dioecious, not borne in strobiles; the staminate flowers composed of numerous stamens, each with 2 pollen sacs; pistillate flowers naked, in pairs, borne on a long stalk enlarged at the apex to form a cup-shaped disk.

Family 1. Ginkgoaceae (Page 1)

A family containing only 1 extant species confined to China.

ORDER CONIFERALES

Resinous trees, the stems increase in diameter by the addition of annual layers of wood inside the bark; flowers unisexual; stamens numerous; ovules and seeds 2 or more, borne on the face of a scale; embryo with 2 or more cotyledons.

Family 2. Pinaceae (Page 3)

With dry seeds and ovules covered by a scale.

Family 3. Taxaceae (Page 41)

With naked ovules and usually fleshy seeds.

CLASS II ANGIOSPERMAE

Carpels or pistils consisting of a closed cavity containing the ovules and becoming the fruit.

Division I. Dicotyledonae

Stems formed of bark, wood or pith and increasing in diameter year after year by the addition of annual layers next to the bark; parts of the flowers mostly in 4's or 5's; embryo with 2 cotyledons; leaves mostly net-veined.

Sub-division I. Apetalae

Flowers without a corolla and sometimes without calyx.

Section 1. Flowers in unisexual ament (pistillate flowers sometimes solitary in *Quercus* and *Juglans*); ovary inferior.

ORDER SALICALES

Flowers without sepals or petals, unisexual, dioecious; disk reduced to a scale; stamens 2 to indefinite; carpels 2; ovary single, with parietal placentae and indefinite ovules; capsule with indefinite seeds; seeds small with basal tufts of hair. Trees or shrubs with simple, alternate leaves; stipules present.

Family 4. Salicaceae (Page 48)

Flowers dioecious, without a calyx; fruit a 2-4 valved capsule. Leaves alternate, simple, deciduous, with stipules.

ORDER MYRICALES

Flowers in catkin-like spikes without sepals or petals, unisexual, monoecious or dioecious; staminate 4 (2-16); carpels 2; ovary 1 celled with a single, basal, erect, atropous ovule; fruit a drupe. Trees or shrubs with simple, rarely divided leaves.

Family 5. Myricaceae (Page 56)

Flowers monoecious or dioecious; fruit a drupe, fleshy or dry; leaves alternate, simple, punctate, persistent, rarely deciduous.

ORDER JUGLANDALES

Flowers in catkins without sepals or petals or with a simple involucre, unisexual, monoecious; stamens 3-40; carpels 2; ovary inferior with basal, erect ovule; fruit winged, drupaceous or a nut. Trees or shrubs with alternate, mostly compound leaves without stipules.

Family 6. Juglandaceae (Page 57)

Flowers monoecious; fruit a nut, dehiscent or indehiscent, or winged; leaves alternate, pinnate, deciduous, without stipules.

ORDER FAGALES

Flowers in catkins or heads, ciolet, with perianth, rarely naked, sometimes perfect, mostly unisexual, monoecious; ovary inferior; carpels 2-6, with 1-2 ovules. Fruit nut-like. Trees or shrubs with simple leaves; stipules present.

Family 7. Betulaceae (Page 68)

Flowers monoecious; fruit a nutlet, winged or wingless, in a strobile or more or less enclosed by a membranous involucre; leaves alternate, simple, deciduous, with stipules.

Family 8. Fagaceae (Page 79)

Flowers monoecious; fruit a nut; more or less inclosed in a scaly cup or spiny involucre; leaves alternate, simple, deciduous or persistent, with stipules.

Section 2. Flowers mostly unisexual; calyx regular; stamens as many as the lobes of the calyx and opposite them; ovary superior, 1 celled.

ORDER URTICALES

Flowers with perianth, rarely naked, small, mostly aggregated in cymose clusters; stamens as many as the perianth segments; carpels 1 or 2; ovary superior, usually 1 celled and 1 ovuled; fruit a nut or a drupe. Herbs or woody plants; leaves with stipules.

Family 9. Ulmaceae (Page 105)

Fruit a samara or a drupe; leaves alternate, simple, usually deciduous, with stipules.

Family 10. Moraceae (Page 120)

Flowers in ament-like spikes or heads; fruits aggregated, inclosed in the thickened calyx of the flower or succulent and berry-like (*Morus*), in a globose head (*Brousonetia*), large with a hard rind (*Cudrania*), or enclosed in a fleshy receptacle (*Ficus*); leaves alternate, simple, deciduous or persistent, with stipules.

Family 11. Urticaceae (Page 127)

Flowers apetalous, regular; stamens inflexed, as many as the calyx lobes; ovary usually superior, 1 celled, 1 ovuled; stigma feathery; fruit an achene or a drupe; leaves alternate or opposite.

Sub-division II. Petalae

Both calyx and corolla present (except in *Trochodendraceae*, *Lauraceae*, *Liquidambar* in *Hamamelidaceae*, *Euphorbiaceae*, and in some species of *Acer*.)

Section 1. Polypetalae. Corolla of separate petals.

A. Ovary superior (partly inferior in *Hamamelidaceae*; inferior in *Malus*, *Sorbus*, *Crataegus*, and *Amelanchier* in *Rosaceae*.)

ORDER RANALES

Flowers spiral or cyclic, rarely naked, mostly with perianth, perigynous to epigynous; stamens mostly numerous; carpels indefinite to 1; free, rarely united. Herbs and woody plants.

Family 12. Trochodendraceae (Page 128)

Flowers monoecious, without perianth or apetalous; carpels 2-many; fruit winged and indehiscent or a follicle; leaves alternate without stipules.

Family 13. Cercidiphyllaceae (Page 132)

Flowers unisexual, dioecious; stamens numerous; carpels 2-5; fruit a many-seeded pod.

Family 14. Magnoliaceae (Page 136)

Flowers perfect, sepals and petals in 3's or a multiple of 3; fruit cone-like or fleshy, composed of numerous cohering carpels; leaves alternate, deciduous or persistent, with stipules.

ORDER ROSALES

Flowers cyclic, rarely spirally arranged with sepals and petals, rarely without petals, hypogynous to epigynous; stamens numerous; carpels sometimes free, sometimes united; ovules indefinite. Herbs, shrubs or trees with alternate leaves, without stipules.

Family 15. Hamamelidaceae (Page 142)

Flowers perfect or unisexual; sepals 4, petals 5 (apetalous in *Liquidambar*); ovary partly inferior; fruit a 2-celled woody capsule, dehiscent at the top; leaves alternate, simple, deciduous, with stipules.

Family 16. Eucommiaceae (Page 144)

Flowers without perianth, dioecious; stamens 6-10 on short filaments; carpels 1 by abortion, with 2 stigmatic lobes at the apex; fruit a samara. Leaves alternate, simple, deciduous, without stipules. The leaves and other parts of the plant with elastic threads.

Family 17. Lauraceae (Page 145)

Flowers perfect or unisexual, apetalous; fruit a drupe or berry; leaves alternate, persistent (except *Sassafras*), with stipules.

Family 18. Rosaceae (Page 163)

Flowers perfect, sepals and petals 5; ovary inferior in *Malus*, *Sorbus*, *Crataegus* and *Amelanchier*; fruit usually a drupe or a pome; leaves alternate, simple or compound, deciduous or persistent, with stipules.

Family 19. Leguminosae (Page 176)

Flowers perfect, regular or papilionaceous; fruit a legume; leaves alternate, usually compound, deciduous or persistent, with stipules.

ORDER GERANIALES

Flowers cyclic, with sepals and petals, or without petals, rarely naked, mostly 5-merous; stamens coherent at the base; ovary superior; carpels 5-2 (rarely more) whorled, usually separating from each other at maturity, mostly with 2-1, rarely more, ovules; ovules pendent, anatropous, with ventral raphe and the micropyle directed upwards.

Family 20. Rutaceae (Page 190)

Flowers perfect, regular; fruit a fleshy drupe or berry, a capsule or drupelets. Leaves alternate, compound or simple, glandular punctate, persistent, rarely deciduous.

Family 21. Simarubaceae (Page 196)

Flowers unisexual, dioecious; sepals and petals 3-5; stamens as many, or twice as many as the petals; ovary 1-6 celled, superior; fruit a drupe, berry, or samara. Leaves usually alternate, compound or simple.

Family 22. Burseraceae (Page 200)

Flowers perfect or polygamous, regular; ovary 2-5 celled, ovules 2 in each cell; fruit drupe-like, dehiscent or indehiscent. Trees or shrubs, resinous; leaves usually alternate; compound, without stipules.

Family 23. Meliaceae (Page 202)

Flowers perfect, regular, 4-5 merous; stamens usually connate; ovary 3-5 celled, style simple; fruit a drupe, berry or capsule. Leaves alternate, usually compound.

Family 24. Euphorbiaceae (Page 207)

Flowers unisexual, perianth simple, calyx-like or wanting; fruit usually a capsule separating in 3 valves; rarely drupe-like or berry-like. Herbs or woody plants with milky juice and alternate, usually simple leaves with stipules.

ORDER SAPINDALES

Flowers as in *Geraniales* but the ovule is in a reversed position, that is, when the ovule is suspended the raphae is dorsal and the micropyle is directed above; when the ovule is upright, the raphae is ventral with the micropyle directed below; ovules 1 or 2 in each cell. Trees or shrubs, also herbs.

Family 25. Anacardiaceae (Page 215)

Flowers regular, perfect or unisexual; calyx 5, petals 3-5; disk present; ovary 1 (2-6) celled; ovules 1 in each cell. Fruit a drupe or nut. Trees or shrubs with alternate, simple or compound leaves.

Family 26. Aquifoliaceae (Page 222)

Flowers perfect, rarely unisexual; sepals and petals more or less connate, sepals 3-6; petals and stamens 4-5; ovary superior; without disk. Fruit berry-like. Leaves simple, alternate or opposite.

Family 27. Staphyleaceae (Page 223)

Flowers perfect, regular, 5-merous; disk cup-shaped; carpels 2-3, free above with many to few pendulous ovules; fruit a capsule, berry, or drupe-like. Trees or shrubs usually with opposite, compound leaves with stipules.

Family 28. Aceraceae (Page 226)

Flowers mostly perfect or polygamous, calyx and corolla and stamens 4-10; carpels 2, each with 2 straight ovules; fruit a samara. Trees or shrubs with opposite, simple, rarely compound leaves.

Family 29. Hippocastanaceae (Page 230)

Flowers perfect or unisexual, irregular; sepals 5; petals 4-5; stamens 4-5; carpels 3, each with 2 ovules; fruit a 3-valved capsule; seeds large. Leaves palmate.

Family 30. Sapindaceae (Page 233)

Flowers unisexual or polygamous; sepals 5; petals 4 or 5 or wanting; stamens usually 10; disk fleshy; ovary superior, 3 celled, each 1 ovuled. Fruit various. Leaves usually alternate, compound.

ORDER RHAMNALES

Flowers cyclic, 4 or 5-merous, sometimes without petals; stamens in 1 whorl, opposite the petals, hypogynous or perigynous; carpels 2-5 with 1 or 2 erect ovules with dorsal, lateral or ventral raphae. Shrubs or trees or climbers.

Family 31. Rhamnaceae (Page 239)

Flowers perfect or polygamous, regular; sepals, petals and stamens 5 or 4; ovary 2-4 celled; ovules solitary in each cell. Fruit a drupe, capsule, or winged nut. Trees or shrubs, rarely herbs.

ORDER MALVALES

Flowers perfect, rarely unisexual, cyclic, both calyx and corolla present; sepals valvate; stamens indefinite or in 2 whorls, the outer one suppressed or reduced to staminodes, the inner one frequently increased in number, and cohering; carpels 2 to indefinite, with 1-indefinite ovules; ovary superior. Trees or woody plants.

Family 32. Tiliaceae (Page 243)

Flowers perfect, regular; sepals and petals 3-5, the latter rarely wanting; stamens numerous; stamens free or connate attached to the disk; ovary superior, 2-10 celled; ovules 1-several in each cell. Fruit a capsule or a drupe, or nut-like, or separating into drupelets or rarely a berry.

Family 33. Sterculiaceae (Page 248)

Flowers perfect or unisexual; sepals 3-5, united; petals wanting or reduced; stamens in 2 whorls, those opposite the sepals reduced to staminodes, those opposite the petals more or less united into a tube; ovary superior, 4-5 celled; fruit dry, rarely fleshy. Trees, shrubs or herbs with alternate simple or digitate leaves.

ORDER PARIETALES

Flowers spiral to cyclic, usually with indefinite stamens and carpels, both calyx and corolla present, hypogynous to epigynous; carpels more or less united, usually with parietal placentae which also may come together in the center, very rarely ovules basal.

Family 34. Theaceae (Page 250)

Flowers usually perfect, regular, showy; sepals and petals usually 5 (4-9); stamens usually numerous; ovary superior 3-5 (-10) celled; ovules usually 2 in each cell; fruit a capsule, drupaceous, or dry and indehiscent. Trees or shrubs with alternate, entire leaves.

Family 35. Flacourtiaceae (Page 251)

Flowers regular, perfect or unisexual; stamens numerous; sepals 2-15; petals 10-0; carpels 2-10 with indefinite ovules on parietal placentae; fruit a berry or a capsule. Trees, shrubs or climbers with alternate, simple leaves with small stipules.

B. Ovary inferior.

ORDER MYRTIFLORAE

Flowers cyclic, both calyx and corolla present, perfect, 4 or 5-merous; carpels seldom free, usually septate. Rarely herbs, mostly shrubs or trees with opposite, simple leaves, without stipules.

Family 36. Eleagnaceae (Page 256)

Flowers perfect or unisexual, apetalous, mostly 4-merous; stamens in 1 or 2 whorls; carpel 1, with 1 basal, erect ovule; fruit appearing drupe-like, enveloped in the fleshy receptacle of the flower. Trees or shrubs, leaves usually with silvery or brown scales.

Family 37. Nyssaceae (Page 258)

Flowers perfect or unisexual, both calyx and corolla present or wanting; sepals 5 or more; petals 5; stamens double the number of the petals, fewer, or more; ovary inferior; 1 or 2 (6-10) celled, usually 1 ovule in each cell. Trees, leaves alternate, simple.

ORDER UMBELLIFLORAE

Flowers cyclic with calyx and corolla, mostly perfect, epigynous, 4-5-merous, rarely indefinite; carpels 1-5, sometimes indefinite, with 1, rarely 2 pendent ovules; seeds with endosperms.

Family 38. Araliaceae (Page 263)

Flowers mostly 5-merous, rarely 3-merous to indefinite, sepals often inconspicuous; stamens seldom more than the petals; carpels indefinite-1; ovary inferior, 2-5 celled; 1 ovule in each cell; fruit berry-like or drupaceous, separating into several stones. Herbs, trees or shrubs with alternate leaves, simple or compound.

Family 39. Cornaceae (Page 266)

Flowers mostly perfect, 4-5-merous to indefinite, mostly with 1 whorl of stamens (2-3), sometimes unisexual. Carpels (4-1) with epigynous disk and usually 1 ovule; drupe 1-4 celled with 1-4 seeds. Trees or shrubs rarely herbs without stipules.

Section 2 Sympetalae. Corolla of united petals.

A. ovary superior (partly inferior in *Styracaceae*).

ORDER EBENALES

Flowers with 2 or 3 whorls of stamens or of one whorl only by abortion, seldom indefinite; petals united; ovary septate with central placentae and 1 or more ovules in each cell. Trees or shrubs with simple leaves.

Family 40. **Ebenaceae** (Page 270)

Flowers 3-6 merous, mostly unisexual, seldom perfect; calyx persistent, often enlarging in the fruit; corolla lobes twisted, seldom valvate in the bud; stamens in the perfect and staminate flowers as many as, or double the number of, or more than, the lobes of the corolla and more or less united; in the pistillate flower staminodal; carpels 2-16; with 1-2 pendulous ovules; style free or united at the base; fruit mostly berry-like with 1-several seeds. Trees or shrubs.

Family 41. **Styraceae** (Page 275)

Flowers 5-4 merous, perfect; sepals and petals united; stamens twice as many as the corolla lobes, united at the base or sometimes wholly united to form a tube; carpels 3-5, with 1 or several ovules; ovary superior, rarely half inferior, 3-5 celled; fruit a capsule, a drupe, rarely winged. Trees or shrubs with more or less stellate pubescence.

ORDER CONTORTAE

Flowers mostly 5-merous, rarely 2-6-merous, mostly sympetalous, rarely choripetalous or apetalous; the stamens of the same number or rarely fewer; carpels 2; stamens mostly united at the base with the corolla; ovary superior; corolla usually contorted in the bud, rarely valvate; herbs or woody plants with simple leaves, without stipules.

Family 42. **Oleaceae** (Page 278)

Flowers 2-6-merous, mostly of united petals, perfect or unisexual; petals absent or 4, 5 or 6 parted; stamens mostly 2, united with the corolla or hypogynous, with short filaments and large anther cells; carpels 2 with 2, seldom 1, or 4-8 ovules, fruit a drupe, berry, capsule or samara. Woody plants, rarely herbaceous; leaves mostly opposite, without stipules.

ORDER TUBIFLORAE

Flowers pentamerous with 4 whorls or sometimes fewer stamens or pistils; stamens united with the corolla; ovary superior, 2 celled with 2 seeds in each cell, sometimes the cells are subdivided by a false partition. Herbs, sometimes trees and shrubs.

Family 43. Boraginaceae (Page 286)

Flowers mostly 5 (rarely 6-indefinite) merous, mostly perfect; calyx persistent; carpels 2, with 2 ovules; ovary 2 celled or 4 celled by the addition of false partitions; style usually 1; stigma 2; fruit composed of 4 nutlets or a drupe. Herbs or woody plants often with coarse hairs or bristly.

Family 44. Scrophulariaceae (Page 287)

Flowers 5-merous, perfect; stamens seldom 5, mostly 4 or 2; carpels 2 with indefinite to fewer ovules; corolla more or less irregular; style 1; fruit a capsule or a berry. Herbs, woody or half-woody with alternate or opposite or whorled leaves.

Family 45. Bignoniaceae (Page 291)

Flowers 5-merous, perfect, more or less bilabiate; stamens 4 or 2, sometimes 5 with 3-1 staminodes; carpels 2 with indefinite ovules; ovary 2 celled, with 2 ovules attached to the partition wall, or 1 celled with 2 parietal placentae; fruit a capsule or fleshy and indehiscent. Trees or woody climbers, rarely herbs.

B. Ovary inferior.

ORDER RUBIALES

Flowers typically 5 or 4-merous; stamens and carpels of the same number or fewer, seldom irregular; ovary inferior, 2 or 3 celled, or 1 celled, with 1-indefinite ovules in each cell; stamens attached to the corolla; herbs or woody plants with mostly simple leaves.

Family 46. Rubiaceae (Page 294)

Flowers 5 or 4 (or more) merous, perfect, rarely unisexual, regular or somewhat irregular; ovary inferior; calyx naked; corolla valvate in the bud; carpels mostly 1-indefinite with 1-indefinite ovules; fruit a capsule, drupe or berry. Herbs or woody plants with opposite or whorled leaves, with stipules.

LIST OF THE GENERA AND SPECIES TREATED IN THIS WORK

GYMNOSPERMAE

GINKGOALES

Ginkgoaceae.

Ginkgo biloba *Linnaeus*.

CONIFERALES

Pinaceae

Larix potaninii *Batalin*.

Larix dahurica *Turczaninow*.

Pseudolarix kaempferi *Gordon*.

Pinus armandi *Franchet*.

Pinus bungeana *Zuccarini*.

Pinus massoniana *Lambert*.

Pinus sinensis *Lambert*.

Picea asperata *Masters*.

Picea montigena *Masters*.

Picea brachytyla *Pritzl*.

Picea aurantiaca *Masters*.

Picea neveitchii *Masters*.

Picea retroflexa *Masters*.

Picea schrenkiana *Fisher & Meyer*.

Picea purpurea *Masters*.

Picea likiangensis *Pritzl*.

Picea glehnii *Masters*.

Tsuga chinensis *Pritzl*.

Tsuga yunnanensis *Masters*.

Pseudotsuga sinensis *Dode*.

Keteleeria davidiana *Beissner*.

Keteleeria fortunei *Carriere*.

Abies delavayi *Franchet*.

Abies recurvata *Masters*.

Abies squamata *Masters*.

- Abies chensiensis Van Tieghem.*
Abies beisneriana Rehder & Wilson.
Cunninghamia lanceolata Hooker.
Cryptomeria japonica D. Don.
Glyptostrobus heterophyllus Endlicher.
Libocedrus macrolepis Benthams & Hooker.
Thuja orientalis Linnaeus.
Thuja sutchuenensis Franchet.
Fokienia hodginsii Henry & Thomas.
Cupressus funebris Endlicher.
Cupressus torulosa D. Don.
Juniperus formosana Hayata.
Juniperus chinensis Linnaeus.

Taxaceae

- Taxus cuspidata Siebold & Zuccarini.*
Cephalotaxus fortunei Hooker.
Cephalotaxus drupacea Siebold & Zuccarini.
Podocarpus neriifolius D. Don.
Torreya grandis Fortune.

ANGIOSPERMAE

DICOTYLEDONAE

Salicaceae

- Salix babylonica Linnaeus.*
Salix matsudana Koidzumi.
Populus simonii Carriere.
Populus lasiocarpa Oliver.
Populus tomentosa Carriere.
Populus tremula Linn. var. davidiana Schneider.
Populus silvestrii Pampanini.
Populus rotundifolia var. duclouxiana Gambocz.
Populus suaveolens Fischer.

Myricaceae

- Myrica rubra Siebold & Zuccarini.*

Juglandaceae

Juglans regia *Linnaeus*.

Juglans cathayensis *Dode*.

Juglans mandshurica *Maximowicz*.

Hicoria cathayensis *Chun*.

Pterocarya stenoptera *De Candole*.

Pterocarya hupehensis *Skan*.

Pterocarya paliurus *Batalin*.

Platycarya strobilacea *Siebold & Zuccarini*.

Englehardtia spicata *Blume*.

Englehardtia chrysolepis *Hance*.

Betulaceae

Ostrya japonica *Sargent*.

Ostryopsis davidiana *Decaisne*.

Carpinus cordata *Blume*.

Corylus chinensis *Franchet*.

Alnus cremastogyne *Burkill*.

Betula japonica *Siebold*.

Betula davurica *Pallas*.

Betula albo-sinensis *Burkill*.

Betula alnoides *Hamilton*.

Betula luminifera *Winkler*.

Fagaceae

Fagus sinensis *Oliver*.

Fagus engleriana *Seeman*.

Castanea mollissima *Blume*.

Castanea henryi *Rehder & Wilson*.

Castanea seguinii *Dode*.

Castanopsis hystrix *De Candole*.

Castanopsis schlerophylla *Schottky*.

Castanopsis fargesii *Franchet*.

Lithocarpus spicata *Rehder & Wilson*.

Quercus variabilis *Blume*.

Quercus mongolica *Fischer*.

Quercus serrata *Thunberg*.

Quercus glandulifera *Blume*.

- Quercus fabri Hance.*
- Quercus aliena Blume.*
- Quercus dentata Thunberg.*
- Quercus glauca Thunberg.*
- Quercus semicarpifolia Smith.*
- Quercus aquifolioides Rehder & Wilson.*
- Quercus gilliana Rehder & Wilson.*
- Quercus oxyodon Miquel.*
- Quercus phillyraeoides Gray.*
- Quercus myrsinaefolia Blume.*
- Quercus spinosa David.*
- Quercus spathulata Seeman.*
- Quercus engleriana Seeman.*
- Quercus acrodonta Seeman.*
- Quercus baronii Skan.*
- Quercus griffithii Hooker.*
- Quercus bambusifolia Hance.*

Ulmaceae

- Ulmus japonica Sargent.*
- Ulmus pumila Linnaeus.*
- Ulmus parvifolia Jacquin.*
- Ulmus macrocarpa Hance.*
- Ulmus laciniata Mayr.*
- Celtis bungeana Blume.*
- Celtis sinensis Persoon.*
- Celtis biondii Pampinini.*
- Celtis julianae Schneider.*
- Trema virgata Blume.*
- Aphananthe aspera Planchon.*
- Zelkova serrata Makino.*
- Hemiptelea davidii Planchon.*
- Pteroceltis tartarinowii Maximowicz.*

Moraceae

- Morus alba Linnaeus.*
- Morus acidosa Griffith.*
- Broussonetia papyrifera L. Heritier.*

Broussonetia kaempferi Siebold.

Cudrania tricuspidata Bureau.

Cudrania javanensis Trecul.

Urticaceae

Debregeasia longifolia Weddell.

Debregeasia edulis Weddell.

Trochodendraceae

Euptelea franchetii Van Tieghem.

Euptelea pleiosperma Hooker & Thompson.

Tetracentron sinense Oliver.

Cercidiphyllaceae

Cercidiphyllum japonicum Siebold & Zuccarini.

Magnoliaceae

Liriodendron chinense Sargent.

Magnolia denudata Desrousseaux.

Magnolia officinalis Rehder & Wilson.

Magnolia wilsonii Rehder.

Magnolia liliflora Desrousseaux.

Hamamelidaceae

Liquidambar formosana Hance.

Eucommiaceae

Eucommia ulmoides Oliver.

Lauraceae

Sassafras tzumu Hemsley.

Cinnamomum camphora Nees.

Cinnamomum cassia Blume.

Cinnamomum zeylanicum Nees.

Phoebe chinensis Chun.

Phoebe nanmu Gamble.

Litsea sericea Hooker.

Litsea citrata Blume.

Litsea faberi Hemsley.

Machilus bournei Hemsley.

Machilus ichangensis Rehder & Wilson.
Lindera megaphylla Hemsley.

Rosaceae

Prunus padus Linnaeus.
Prunus persica Stokes.
Prunus mira Kuhn.
Prunus triflora Roxburgh.
Prunus mume Siebold & Zuccarini.
Amelanchier sinica Chun.
Eriobotrya japonica Lindley.
Sorbus alnifolia Koch.
Malus malus Britton.
Malus baccata Borkhausen.
Malus theifera Rehder.
Crataegus pinnatifida Bunge.

Leguminosae

Albizzia julibrissin Durazzini.
Albizzia lebbek Benth.
Cercis chinensis Bunge.
Cercis racemosa Oliver.
Gymnocladus chinensis Baillon.
Gleditsia macraecantha Desfontaines.
Gleditsia sinensis Lamarek.
Gleditsia delavayi Franchet.
Gleditsia japonica Miquel.
Sophora japonica Linnaeus.
Ormosia hosiei Hemsley & Wilson.
Ormosia henryi Hemsley & Wilson.
Cladrastis chinensis Hemsley.
Maackia amurensis Ruprecht.
Maackia hupehensis Takeda.
Dalbergia hupeana Hance.

Rutaceae

Phellodendron amurense Ruprecht.
Phellodendron sachalinense Sargent.

- Phellodendron chinense* *Schneider*.
Citrus medica *Linnæus*.
Poncirus trifoliata *Rafinesque*.
Evodia glauca *Miquel*.
Zanthoxylum micranthum *Hemsley*.
Zanthoxylum piperitum *De Candole*.
Zanthoxylum bungei *Planchon*.

Simarubaceae

- Ailanthus altissima* *Swingle*.
Ailanthus vilmoriniana *Dode*.
Picrasma quassioides *Bennet*.

Burseraceae

- Canarium album* *Raenschel*.
Canarium pimela *König*.

Meliaceae

- Cedrela sinensis* *Jussieu*.
Melia azederach *Linnæus*.
Cipadessa baccifera *Miquel*.

Euphorbiaceae

- Aleurites fordii* *Hemsley*.
Aleurites cordata *Brown*.
Aleurites montana *Wilson*.
Mallotus tenuifolius *Pax*.
Mallotus philippinensis *Mueller*.
Croton tiglium *Linnæus*.
Bischofia javanica *Blume*.
Sapium sebiferum *Roxburgh*.
Daphniphyllum macropodum *Miquel*.

Anacardiaceae

- Spondias axillaris* *Roxburgh*.
Pistacia chinensis *Bunge*.
Rhus verniciflua *Stokes*.
Rhus succedanea *Linnæus*.
Rhus javanica *Linnæus*.

Aquifoliaceae

Ilex pernyi *Franchet*.

Staphyleaceae

Staphylea holocarpa *Hemsley*.

Tapiscia sinensis *Oliver*.

Aceraceae

Acer henryi *Pax*.

Acer pictum *var parviflorum* *Schneider*.

Acer cappadocicum *Gleditsch*.

Acer oblongum *Wallich*.

Acer palmatum *Thunberg*.

Acer davidii *Franchet*.

Acer trifidum *Hooker & Arnot*.

Dipteronia sinensis *Oliver*.

Hippocastanaceae

Aesculus chinensis *Bunge*.

Aesculus wilsonii *Rehder*.

Sapindaceae

Sapindus mukorossi *Gaertner*.

Euphoria longana *Lamarck*.

Litchi chinensis *Sonnerat*.

Koelreuteria paniculata *Laxmann*.

Koelreuteria bipinnata *Franchet*.

Rhamnaceae

Rhamnus davuricus *Pallas*.

Rhamnus utilis *Decaisne*.

Rhamnus crenatus *Siebold & Zuccarini*.

Ziziphus jujuba *Lamarck*.

Ziziphus sativa *Gaertner*.

Paliurus orientalis *Hemsley*.

Hovenia dulcis *Thunberg*.

Tiliaceae

- Tilia tuan* *Szyszyłowicz*.
Tilia oliveri *Szyszyłowicz*.
Tilia mongolica *Maximowicz*.
Tilia mandshurica *Ruprecht & Maximowicz*.
Tilia henryana *Szyszyłowicz*.
Tilia chinensis *Maximowicz*.
Tilia paucicostata *Maximowicz*.

Sterculiaceae

- Sterculia lanceaefolia* *Roxburgh*.
Firmiana simplex *W. F. Wight*.
Reveesia pubescence *Masters*.

Theaceae

- Stewartia sinensis* *Rehder & Wilson*.
Gordonia axillaris *Szyszyłowicz*.
Gordonia sinensis *Hemsley & Wilson*.

Flacourtiaceae

- Itoa orientalis* *Hemsley*.
Poliothyrsis sinensis *Oliver*.
Idesia polycarpa *Maximowicz*.
Xylosma racemosum *Miquel*.
Carrierea calycina *Franchet*.

Eleagnaceae

- Eleagnus umbellata* *Thunberg*.
Hippophae rhamnoides *Linnaeus*.

Nyssaceae

- Camptotheca acuminata* *Decaisne*.
Nyssa sinensis *Oliver*.
Davidia involucrata *Baillon*.

Araliaceae

- Aralia chinensis* *Linnaeus*.
Aralia wilsonii *Harms*.
Acanthopanax ricinifolius *Seeman*.

Cornaceae

- Cornus kousa* *Buerger*.
Cornus capitata *Wallich*.
Cornus controversa *Hemsley*.
Cornus macrophylla *Wallich*.

Ebenaceae

- Diospyros lotus* *Linnaeus*.
Diospyros kaki *Linnaeus*.

Styraceae

- Pterostyrax micranthum* *Siebold & Zuccarini*.
Pterostyrax corymbosus *Siebold & Zuccarini*.
Styrax japonicus *Siebold & Zuccarini*.
Alniphyllum fortunei *Perkins*.

Oleaceae

- Fraxinus chinensis* *Roxburgh*.
Fraxinus mariesii *Hooker*.
Fraxinus platypoda *Oliver*.
Fraxinus mandshurica *Ruprecht*.
Fraxinus bungeana *De Candolle*.
Fraxinus griffithii *Clarke*.
Fraxinus retusa *Champion*.
Fraxinus paxiana *Lingelsheim*.
Chionanthus retusus *Lindley & Paxton*.
Osmanthus fragrans *Loureiro*.
Osmanthus armatus *Diels*.
Ligustrum lucidum *Aiton*.

Boraginaceae

- Ehretia acuminata* *R. Brown*.

Scrophulariaceae

- Paulownia tomentosa* *Koch*.
Paulownia fortunei *Hemsley*.

Paulownia duclouxii Dode.

Paulownia fargesii Franchet.

Paulownia silvestrii Pampanini & Bonat.

Paulownia thyrsoidea Rehder.

Bignoniaceae

Catalpa ovata G. Don.

Catalpa fargesii Bureau.

Catalpa bungeii Meyer.

Catalpa duclouxii Dode.

Catalpa vestita Diels.

Rubiaceae

Adina cordifolia Hooker.

Adina racemosa Miquel.

Emmenopterys henryi Oliver.

Errata

- Page 11. Line 25 read *leaves with 2 fibrovascular bundle scars*.
- „ 20. *Pseudolarix kaempferi* has now been changed to *Pseudolarix ambabilis* Rehder. (For full synonymy see Journal of the Arnold Arboretum, Vol. 1, No. 1, Page 53.)
- „ 30. *Abies beisneriana* read *beissneriana*.
- „ 31. (*Taodium heterophylla*) read (*Taxodium heterophyllum* Brongniart.)
- „ 16. *Podocarpus nerifolia* read *Podocarpus neriifolius* D. Don.
- „ 51. *Populus tremula* Linn. var. *Davidiana* read *Populus tremula* var. *dauidiana* Schneider.
- „ 76. *Betula alba* Turczaninow read *Turczaninow*.
- „ 86. *Castanea vilmoriana* read *vilmoriniana*.
- „ 97. *Quercus aliena* var. *acutiserrata* read *acutesserrata*.
- „ 105. *Quercus schottkeyana* read *schottkyana*.
- „ 111. *M. hypolenca* read *hypoleuca*.
- „ 161. *Prunaphora* read *Prunophora*.
- „ 188. *Cladrastis chinensis* read *sinensis*.
- „ 240, 241. *Ziziphus* read *zizyphus*.
- „ 247. *Tilia bobilis* read *nobilis*.
- „ 249. (*Firmiana planlanifolia*) read *platanifolia*; *Reevesia pubescence* read *pubescens*.
- „ 256. *Idea* read *Idesia*; *Eleagnaceae* and *Eleagnus* read *Elavagnaceae* and *Elaagnus*.
- „ 259. Lines 25 & 29 *Jupelo* read *Tupelo*.
- „ 279. Var. *rhynchopylla* read *rhynchophylla*.
- „ 281. *Fraxinus mandschurica* read *mandshurica*.

CLASS I GYMNOSPERMAE

GINKGOACEAE

Dioecious trees with deciduous fan-shaped leaves, without stipules; strobile wanting; staminate flowers in pairs on pedicels borne on a slender axis, catkin-like; pistillate flowers naked in pairs on long stalks. Fruit drupaceous.

A family containing 1 extant species confined to China.

GINKGO

Trees. Leaves deciduous, alternate, scattered on vigorous or long shoots, crowded at the apex of spurs or short lateral shoots. Leaves stalked, parallel veined, fan-shaped or broadly wedge shaped, entire or wavy margined or more or less cleft into 2 or more lobes, the margins somewhat thickened. Flowers small and inconspicuous, developing with the unfolding of the leaves from short lateral spurs. They are usually dioecious; the male flowers in short pendulous catkins, each bearing numerous stamens; the pistillate, as naked ovules in pairs on long stalks, although only 1 ovule develops into fruit in most cases, after fertilization becoming enveloped in a fleshy covering. Fruit a drupe, solitary or more rarely in pairs, plum-like, about 3 cm. long, glabrous, orange with a glaucous bloom. When fully ripe, the skin is thin, the flesh soft, oily, acrid, containing a large, thin-shelled, white or cream colored seed which is edible. The pulp of the ripe fruit has an unpleasant, acrid flavor or odor.

The genus *Ginkgo* is the only representative of the family and is regarded as the oldest genus of trees surviving from prehistoric times, extinct species having been found in the Jurassic and succeeding epochs. It is represented by only one living species.

Propagated by seeds. Between 265 and 272 seeds weigh one pound. The seeds germinate in about 50 days after sowing.

***Ginkgo biloba* Linnaeus.**

(*Salisburia adiantifolia*. Smith)

Maiden Hair Tree.

The generic characters above given are sufficient description of the species.

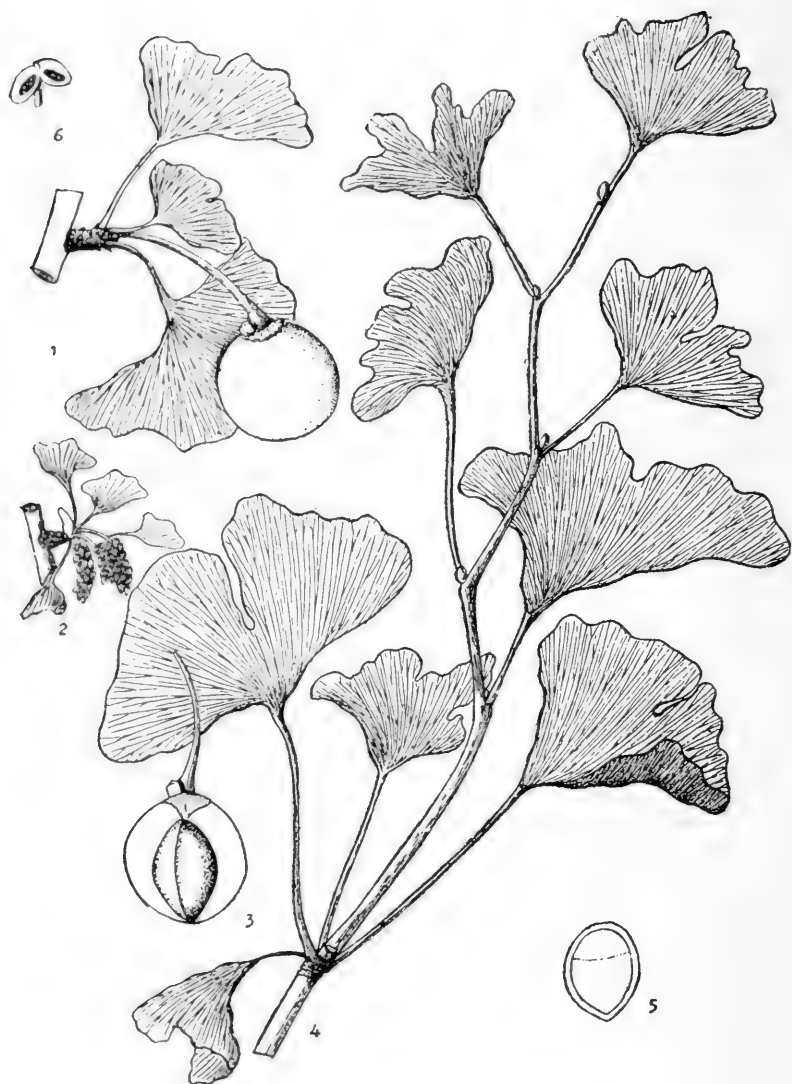


Plate 2. GINKGO BILOBA Linnaeus

1. Fruiting branch ; 2. Flowering branch ; 3. Section of fruit, exposing seed ; 4. Sterile branch ; 5. Section of seed ; 6. Stamen, enlarged.

When young *Ginkgo biloba* is a slender pyramidal tree. With age under favorable conditions it may attain 30 m. or more in height and 3 m. in diameter of trunk. Although generally regarded as native only in China, *Ginkgo biloba* is not now certainly known to be aboriginal or truly wild in any part of the country. It has been reported by Meyer as growing spontaneously in Chekiang Province, where it was cut for firewood, but others doubt it is truly spontaneous there. On account of sentimental attachments, the tree is not often cut down, and the wood therefore seldom finds its way in the market. The wood is soft, but straight grained, light brownish in color with a silky sheen. It is used for making abacus beads, seals and other small fancy articles. In Japan it is extensively used for the ground work of the lacquer ware. The Japanese use the leaves for fertilizer, especially in rice fields under water. They ascribe to the leaves an insecticidal power. A leaf of the *Ginkgo* used as a book-mark will keep away insects that attack books.

PINACEAE

Flowers monoecious, rarely dioecious; ovules 2 or more; fruit a woody cone (berry-like in *Juniperus*); cotyledons 2 or more; leaves needle-shaped, linear or scale-like, persistent (deciduous in *Larix*, *Pseudolarix*, *Glyptostrobus*).

The family includes 29 genera and about 245 species subdivided into 4 tribes of which the *Araucarineae* tribe is alone unrepresented in China, being confined mostly to the Southern hemisphere.

16 genera occur in China.

KEY TO THE CHINESE GENERA

Abietineae. Leaves spirally arranged; ovuliferous bract and scale always distinct; ovules 2, reversed; cone scales usually with 2 winged seeds; pollen grains winged; leaves needle-like.

I. Leaves deciduous, fascicled or spirally arranged or both.

- A. Staminate inflorescence solitary, globose; cone scales persistent.
..... *Larix*.
- B. Staminate inflorescence clustered, stalked; cone scales deciduous at maturity *Pseudolarix*.

II. Leaves evergreen.

A. Fruit maturing in 2 or rarely 3 seasons; leaves needle-shaped, in clusters of 1-5 inclosed at the base by a sheath; cone scales woody, much longer than the bracts *Pinus*.

B. Fruit maturing in 1 season.

1. Cones pendulous, the scales persistent.

a. Branchlets roughened by the persistent leaf bases; leaves deciduous upon drying; bracts shorter than the cone scales.

(1) Leaves sessile, 4 sided, stomatiferous on all 4 sides or somewhat flattened and stomatiferous above. *Picea*.

(2) Leaves stalked, flattened and stomatiferous below or somewhat angular *Tsuga*.

b. Branchlets not roughened by the persistent leaf bases; leaf stalked, flattened; aristate bracts longer than the scales *Pseudotsuga*.

2. Cones erect, the scales persistent or deciduous.

a. Cone scales persistent; seeds about as long as the scales; bracts shorter than the scales; leaves flattened, keeled above, pale below *Keteleeria*.

b. Cone scales deciduous; seeds shorter than the scales; bracts shorter or longer than the scales; leaves flattened, grooved above, usually pale below, 4 angled *Abies*.

Taxodineae. Leaves spirally arranged, ovuliferous bracts and scales almost completely coalescent; ovules 2-8, upright or finally reversed; cone scales with 2-8 seeds; pollen grains wingless; leaves linear or scale-like.

I. Leaves persistent.

A. Leaves lanceolate, flat, large, glaucous beneath; cone elongated, scales serulate and reflexed at the apex *Cunninghamia*.

B. Leaves awl-shaped, curved, small; cones globose with peltate scales, 3-5 toothed at the apex; seeds angled *Cryptomeria*.

II. Leaves and short branches deciduous; cone scales deciduous. *Glyptostrobus*.

Cupressineae. Leaves opposite or whorled, often scale-like; ovules upright; strobiles may ripen fleshy.

- I. Fruit a cone; leaves scale-like or sometimes needle-like on juvenile branches.
 - A. Scales of cone imbricate or valvate, oblong; seeds 2 under each scale, maturing in 2 years.
 1. Scales of cone 6, only the middle ones fertile; seeds unequally 2 winged.....*Libocedrus*.
 2. Scales of cones 8-12; the 2 upper pairs fertile; seeds equally 2 winged (wingless in our species).....*Thuya*.
 - B. Scales of cone peltate:
 1. Cones small; wings of seeds very large, unequal; seeds 2. *Fokienia*.
 2. Cones rather large and woody; seeds many under each scale; fruits maturing in 2 seasons*Cupressus*.
- II. Fruit fleshy, an indehiscent berry or drupe; ovules in 2's or solitary; flowers dioecious; leaves scale-like or needle-shaped, and in 3's, (often of 2 forms)*Juniperus*.

LARIX

Deciduous coniferous trees, with elongated, slender leading branchlets and short spur-like lateral branchlets on the twigs after the first year. Leaves linear or needle shaped, 3 or rarely 4 angled, remote and spirally arranged on the leading shoots, crowded in a tuft on the short spurs, deciduous in the autumn. Flowers monoecious, unisexual, solitary, the staminate on short, leafless spurs, composed of numerous spirally arranged short-stalked stamens with yellow anthers. Pistillate flowers on lateral spurs, globose, erect, composed of several orbicular scales in the axils of long, mucronate, usually scarlet bracts. Fruit a cone with exserted or included bracts and persistent scales, each bearing 2 winged seeds. Seeds nearly triangular, shorter than their wings, ripening and falling in one year.

The larches are widely distributed over the cool parts of the N. Hemisphere, forming pure forests and extending across Canada and the N. United States in America, and over Central Europe, the Himalayas,

China and Japan, as far north as Siberia. About 40 species are recognized. They are timber trees that thrive best in regions of abundant rainfall and no other forest tree reaches farther north than the larch. The wood is hard, tough and durable, of a brownish color, very valuable for construction purposes. The bark is rich in tannin. For reforestation in China the European larch, *Larix larix* (*Larix europea* or *L. decidua*) and the western American species, *Larix occidentalis*, should be subjected to thorough experimentation. Unfortunately the larches are liable to insect and fungus infestations. The larch blight is caused by a woolly insect (*Chermies abietis*) which lives upon the fir as an alternate host. The common fungus parasite is *Dasyscypha calycina*. The larches are propagated most readily by seeds, handled in much the same manner as are the seeds of other conifers. About 60,000 seeds weigh 1 oz.

The demand for larch lumber for general construction, posts and poles, pillars, and railroad ties, for bridge, house and boat construction, can be met only by the establishment of extensive forests in the northern and western provinces where conditions are favorable for their culture.

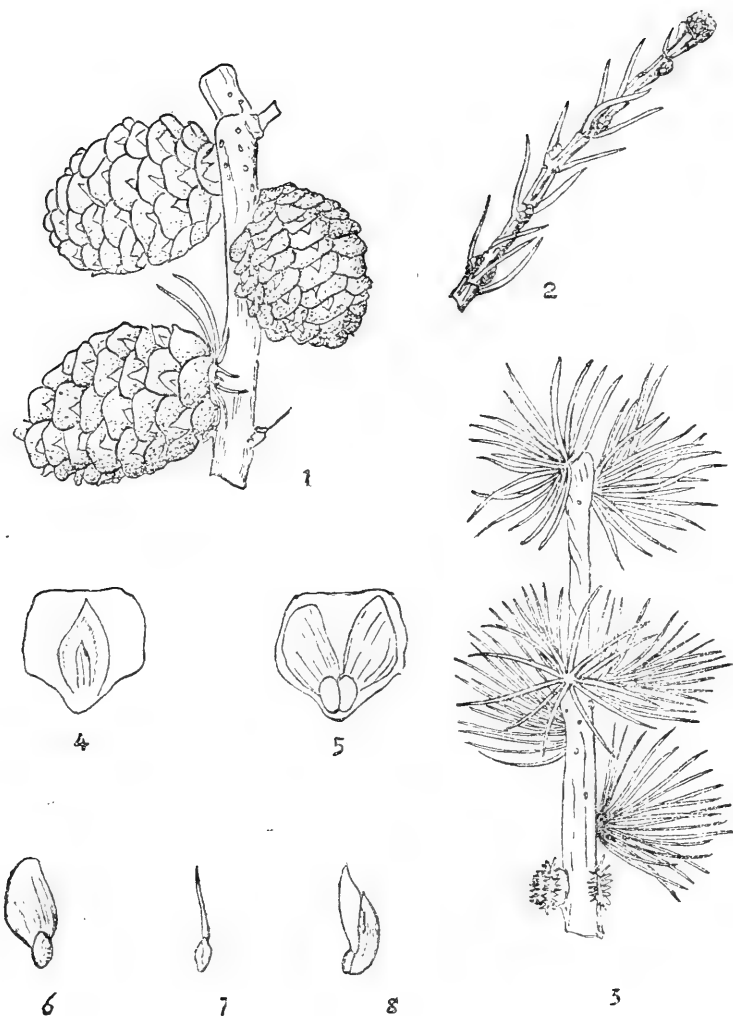
***Larix potaninii* Batalin.**

(Hung Hsa) Red Larch.

Tree 25 m. tall with fissured, gray-brown bark and spreading horizontal branches. Branchlets pendulous, bright yellow, becoming gray, more or less pubescent. Leaves about 3 cm. long, slightly 4 angled, pointed or obtuse, greenish or gray-green. Staminate flowers about 7 mm. long. Pistillate flowers ovoid, with reflexed, later erect bracts. Cones 3.5-4.5 cm. long, cylindrical and symmetrical, reddish at first, purple at maturity and finally grayish or gray-brown; the scales rounded, the bracts always exserted and pointed.

Szechuan, Kansu, Shensi and Yunnan.

This tree is abundant in Western Szechuan where it occurs in company with the birches and the silver firs on the lower slopes; on higher altitudes it forms pure stands. Not far from Tachien Lu in Western Szechuan extensive forests containing individuals measuring 70 and 80 feet tall, have been reported. The tree is known as the "Red Fir" to the mountaineers and produces the most valuable timber of any conifer in China.

Plate 3. *LARIX POTANINII* Batalin

1. Cones; 2. Flowering branch; 3. Sterile branch; 4. Scale; 5. Scale with seeds; 6. Seed; 7. Side view of seed; 8. Side view of scale and seed.

Larix dahurica Turczaninow.

Tree to 20 m. tall. Branchlets tomentose. Buds yellow-brown and blackish at the base. Leaves about 4 cm. long. Cones usually 2-4 cm. long, sometimes longer; scales 20 or more, rounded or notched or truncated at the apex, shiny brown.

E. Siberia to N. China.

PSEUDOLARIX

Deciduous coniferous trees with linear or needle-like leaves spirally arranged on terminal shoots, whorled or tufted on short lateral spurs. Staminate flowers yellow, on the end of a spur. Cones large, with thick, woody, triangular scales, deciduous from the central axis. Ripening in 1 season.

One species in China.

Pseudolarix resembles the true larches but the leaves are larger and broader. They are yellow-green in the spring, turning golden yellow before falling in the autumn. The staminate flowers of *Pseudolarix* are clustered, the cone is large with thick triangular scales, deciduous from the central axis, while in *Larix*, the staminate flowers are solitary and the cone has persistent scales. The Golden Larch is frequently dwarfed in pots. In nature it attains to a large size, and fine specimens still survive in the grounds of 2 temples west of Ningpo in Chekiang.

There are good reasons to believe that *Pseudolarix* was once very common within its range, but it has been gradually cut off until very few of the trees are seen in a wild state to-day. The Government Forest Service is planting a large area to the Golden Larch in an effort to save it from extinction.

Pseudolarix Gordon.

(Ging Tsung.) Golden Larch.

Tree up to 40 m. tall, with scaly red-brown bark. Leaves 3.5-4 cm. long, sharp pointed, slightly curved above. Staminate flowers, 20-30 in a cluster; anthers 20, 2 celled, opening transversely to discharge the pollen grains, which, unlike the simple pollen grains of *Larix*, are winged (as in *Pinus*). Cones 2-5 cm. long, about as broad, ovoid, erect. The scales are numerous, woody, reddish-brown when ripe, acute or notched at the apex, adnate to an ovate-lanceolate bract. Seeds with long articulate wing.



Plate 4. *PSEUDOLARIX KAEMPFERI* Gordon

1 Staminate flower clusters, enlarged; 2. Staminate flower clusters: 3. Cone; 4. Cone scale; 5. Seed. (After Veitch).

Chekiang, Kansu, Kiangsi.

A very handsome ornamental tree on account of its golden yellow foliage in the autumn. When judiciously used it produces a charming effect in a landscape.

PINUS

Evergreen and resinous trees or rarely shrubs, usually with whorled branches. Winter buds covered by imbricated scales. Leaves in fascicles of 2, 3 or 5, rarely single or more than 5, surrounded at the base by a persistent or deciduous sheath. In the seedling stage, the leaves (called primary leaves) which succeed the cotyledons are thin, flat, solitary and spirally arranged. They function as leaves for a period of 1 to 3 years, gradually becoming reduced to bract-like scales from whose axes spring the fascicled leaves which form the permanent foliage, and persist from one to several years. Flowers monoecious. The staminate flowers in catkin-like clusters, yellow, orange or scarlet, borne on the base of the shoot, composed of numerous sessile, 2 celled anthers with bract-like connectives, surrounded at the base with a 3-6 lobed scale-like bract. Pistillate flowers green or purplish, solitary or clustered, subterminal or lateral on a shoot of the current year's growth, composed of numerous spirally arranged ovuliferous scales, each in the axil of a bract. Ovules 2 to each scale. The pistillate flowers are usually erect, after pollination they become drooping, but fertilization does not take place until the following season, so that normally, the fruit requires 2 years to mature. Fruit a woody cone, with numerous appressed scales, each bearing 2 seeds at its base. The cone scales are variously modified. The exposed portion of the conelet of the first season's growth is known as the umbo, and the later and larger growth of the cone scale developed during the second year is called the apophysis. Seeds wingless, imperfectly winged or winged; wings articulate or not detachable.

About 60 species in the Northern Hemisphere; 12 species in Asia, of which 4 occur in China proper. The pines are important timber trees, and considering their range and abundance, constitute the most important arborescent genus. The wood is soft, easily worked and durable. The seeds of the nut pines are edible. Propagation is generally by seeds. The seed in germination, carries its seed coat like a hood on the tips of the cotyledons.

According to Shaw, the latest monographer of the genus, only 4 pines are indigenous to China proper. *Pinus koraiensis* and *Pinus densiflora* from Korea and Japan are commonly met with in gardens and seem to be naturalized in some places. *Pinus koraiensis* may be distinguished from *P. armandi* to which it is closely allied by the tomentose branchlets, indehiscent cone and large distinctive seeds which are also edible. It is a hardy, rapid growing tree, producing valuable timber, well worth growing in temperate regions. *Pinus densiflora*, which belongs in the same subsection (Pinaster) with *Pinus massoniana*, differs from the Chinese tree by shorter needles, (8-12 cm. long) and by shorter, persistent cones whose scales are pale yellow rather than nut brown. *P. thunbergii*, another commonly planted Japanese species, is distinguished from all Chinese pines by the white buds.

The Chinese pines are grouped into 2 sections as follows:—

Section 1, Soft Pines (*Haploxyton*).

Bases of bracts subtending needle clusters not decurrent; sheath of needles deciduous; leaves with 1 fibrovascular bundle scar; cone symmetrical, soft, with few scales; wood soft, fairly uniform in color, slightly resinous, with indistinct rings of annual growth; seeds wingless or with ineffective wing.

1. 5-needled pine *Pinus armandi*.
2. 3-needled pine *Pinus bungeana*.

Section II, Hard Pines (*Diploxyton*).

Bases of bracts subtending needle clusters decurrent; sheath of needles usually persistent; leaves with 1 fibrovascular bundle scar; cones more or less symmetrical with stiffer scales; wood hard, with a marked contrast between spring and summer wood, very resinous. Seeds winged.

1. Leaves 2 (2 or 3) in a sheath, long, pliant; cones deciduous, large; confined to warm temperate regions *Pinus massoniana*.
2. Leaves 3 (3 or 2) in a sheath, shorter, stouter; cones short, persistent; confined to mountain tops or colder regions.... *Pinus sinensis*.

***Pinus armandi* Franchet.**

Chinese White Pine

A medium sized tree, up to 25 m. tall. Branchlets glabrous, at first olive green, later gray. Winter buds cylindric, reddish-brown. Leaves

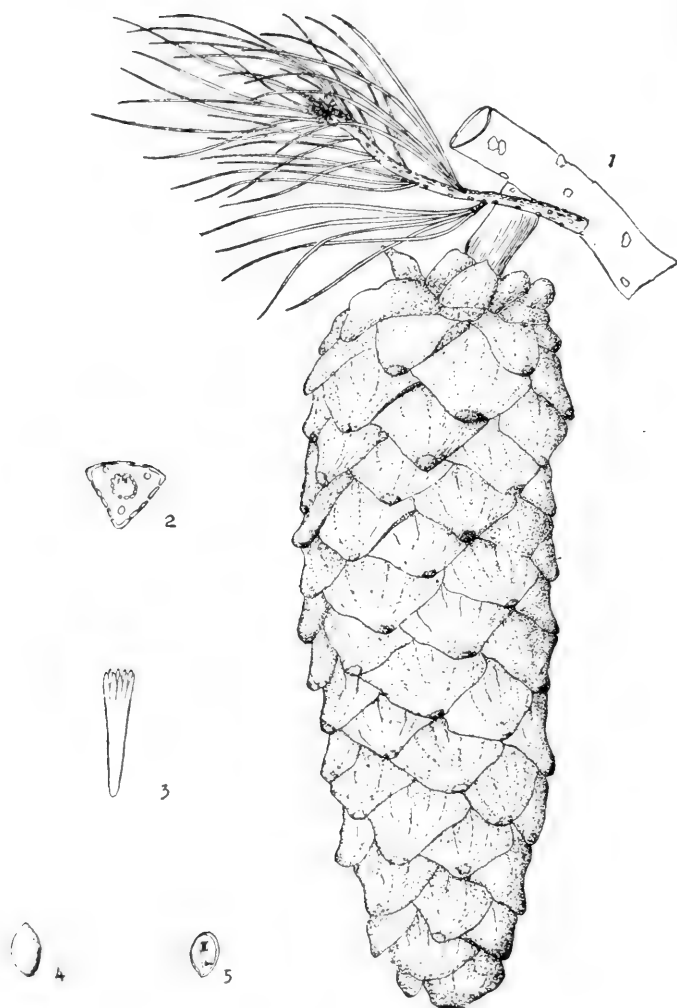


Plate 5. *PINUS ARMANDI* Franchet

1. Fruiting branch; 2. Section of leaf, enlarged; 3. Embryo, enlarged;
4. Seed; 5. Section of seed.

in 5's, slender and spreading, serrulate, 8-15 cm. long; sheath early deciduous. Staminate flowers 2 cm. long, cylindric, yellow, with spatulate scales at the base. Cones 6-20 cm. long, oblong cylindrical, yellowish-brown, pendent on peduncles which sometimes remain on the tree after the cone has fallen away; the scales dull or slightly lustrous, tapering to a slightly thickened umbo, sometimes a little reflexed; umbo not prominent. Seeds wingless, reddish-brown, ovoid, compressed, with a sharp ridge around the edge, 12 mm. long.

In the mountains of C. and W. China, Hupeh, Szechuan, Yunnan and Shensi, to Formosa.

The tree has a pale gray, smooth bark and a shapely habit. It occupies rocky situations and seldom forms pure stands. The wood is soft, close grained and resinous, esteemed for its durability, used for building purposes as well as for cheaper grades of furniture. The seeds are edible. Planted in Europe and America as an ornamental tree. The seeds are sold in the markets, esteemed as a delicacy.

***Pinus bungeana* Zuccarini.**

White Bark Pine. (Bai Tsung)

Tree 5-20 m. tall, sometimes divided into several stems. Bark dark brown, scaling off into thin, irregular flakes, exposing the chalky white inner bark. On old trees the bark becomes conspicuously white by the flaking off of outside layers. Branches long and slender; branchlets glabrous, gray-green. Leaves 6-10 cm. long, in bundles of 3's, rigid, acute, light green, edges serrulate; sheath early deciduous. Staminate flowers in loose spikes, 10 cm. long. Cones solitary or in pairs, almost sessile, subterminal or pseudolateral, short ovate, 5-7 cm. long. Scales yellow or yellow-brown, the apophysis with a transverse ridge at the upper margin and a pointed, recurved umbo. Seeds brownish, with a short, ineffective, loosely attached wing which sometimes remains in the cone after the seed has fallen. Seeds ovate, about 9-13 mm. long.

This pine is planted in temple grounds and courtyards, and is rarely seen in a wild state. There are indications that this tree once formed extensive forests. In the temple of Tieh Ta Tsze, near Peking, is a celebrated tree of this species named by the Emperor Chien Lung, "Chiu Lung Tsung"—the Pine of the Nine Dragons. *Pinus bungeana* is a slow growing tree, with coarse, brittle wood. The white bark is distinctively conspicuous and ornamental. This pine has a tendency to branch into several stems which add to its decorative value.

***Pinus massoniana* Lambert.**

Chinese Red Pine.

Tree 20 rarely 30 m. tall, with yellow-brown, slender, uninodal branchlets. Leaves 2 in a bundle, rarely 3, 12–20 cm. long, very slender and pliant, light green; edges serrulate. Staminate catkins often in long, dense clusters. Cones 4–7 cm. long, symmetrical, oblong ovate, or ovate conic, short pedunculate, dull brown, early deciduous; apophysis flattened, slightly ridged, with a small flat umbo. Seeds winged; wing articulate.

The common pine in the warm temperate regions of China, from Hongkong to Fukien and northward into W. Szechuan. Occasionally planted as a source of fuel. The wood is variable in texture and durability and only the timber from trees grown in favorable situations is suitable for construction purposes. This pine is sometimes confused with *Pinus densiflora* which Shaw does not credit as being indigenous to China. *Pinus densiflora* has shorter leaves, pale yellow cones and conelets with dorsal, free, sharp pointed umbo. From *P. sinensis*, it is distinguished by its long clustered inflorescence, leaves in 2's, not 3's, and by the light brown deciduous cone.

The bark of this tree is dark gray, fissured into large rectangular blocks. The bark of the upper branches of the crown is reddish and flaky.

***Pinus sinensis* Lambert.**

Chinese Hard Pine.

Tree to 25 m. tall. Bark on trunk dark gray and fissured, on branches red and flaky. Branchlets pale orange-yellow or grayish yellow, pruinose when young. Winter buds oblong, lustrous, brown, somewhat resinous. Leaves usually in 2's, sometimes in 3's, or both, 10–15 cm. long, stout and stiff, glaucescent, serrulate. Staminate flowers in short clusters. Conelets mucronate. Cones short, 4–9 cm. long, ovate, pale yellow-brown, symmetrical or oblique, persistent for several years, deciduous at maturity; apophysis swollen, ridged, blunt or slightly mucronate. Seeds brown and mottled and winged, 2 cm. long.

A cold temperate species on the mountains of C. and W. China and on lower levels in the Northern Provinces and in Korea. Fine specimens of this pine are growing on the grounds of the Temple of Heaven in Peking. This is a very variable species, exhibiting extreme differences

in the length of leaves and size and symmetry of cones. The wood is hard and durable, valuable for construction purposes. The following forms cannot always be distinguished from the type:

Var. yunnanensis (Franchet) Shaw.

(*P. yunnanensis* Franchet)

Has the largest leaf and the longest cone.

Var. densata (Masters) Shaw.

(*P. densata* Masters).

Oblique cone with swollen, prominent apophysis.

The length of the needles and size of the cones vary according to ecological factors, *var. yunnanensis* representing the species growing in its optimum range.

Pinus sinensis is characterized by short clustered staminate flowers and by the persistent cones, changing in color from pale yellow to dark brown.

PICEA

Evergreen trees usually with whorled, horizontal branches and thin scaly bark. Leaves spirally arranged, linear, awl-shaped, usually 4 angled and with a white line on each of the 4 faces, or more or less flattened and then marked by white lines on the upper surface only, attached to angular, persistent woody leaf bases from which they are deciduous upon drying. Flowers monoecious, catkin-like; the staminate red or yellow, composed of numerous spirally arranged anthers with broad scale-like connectives; the pistillate greenish or purple composed of numerous spirally arranged scales and bracts which are shorter than the scales at maturity, each scale bearing 2 ovules on the inner surface near the base. Fruit a pendent cone with persistent scales. Seeds usually acute at the base, winged.

About 38 species are recognized; probably not more than 10 or 12 well defined species occur in China. The spruces are widely distributed over the colder temperate regions, often forming pure forests of some extent. *Picea* is well characterized by the more or less 4 angled, acicular leaves falling away upon drying, articulated to persistent woody bases, (sterigmata) and by pendent cones whose scales persist on the central axis and spread open to liberate the seeds. In *Abies* the cones are erect,

usually high on the tree, at maturity falling apart, the seeds and scales together. The spruces are for the most part important timber trees producing a soft, light, straight-grained wood which is not, however, over durable in contact with the soil. The wood is much used for general construction, interior finish, ship-building, for making musical instruments and for fuel. Many species are well adapted for planting as windbreaks, tall hedges and for ornamental purposes. The spruces can stand shade and thrive well on thin soil, being shallow rooted, and they should prove useful for reforesting the northern regions.

The Chinese species are greatly confused and the genus requires a thorough study before we can be certain of the actual number of species occurring in this country.

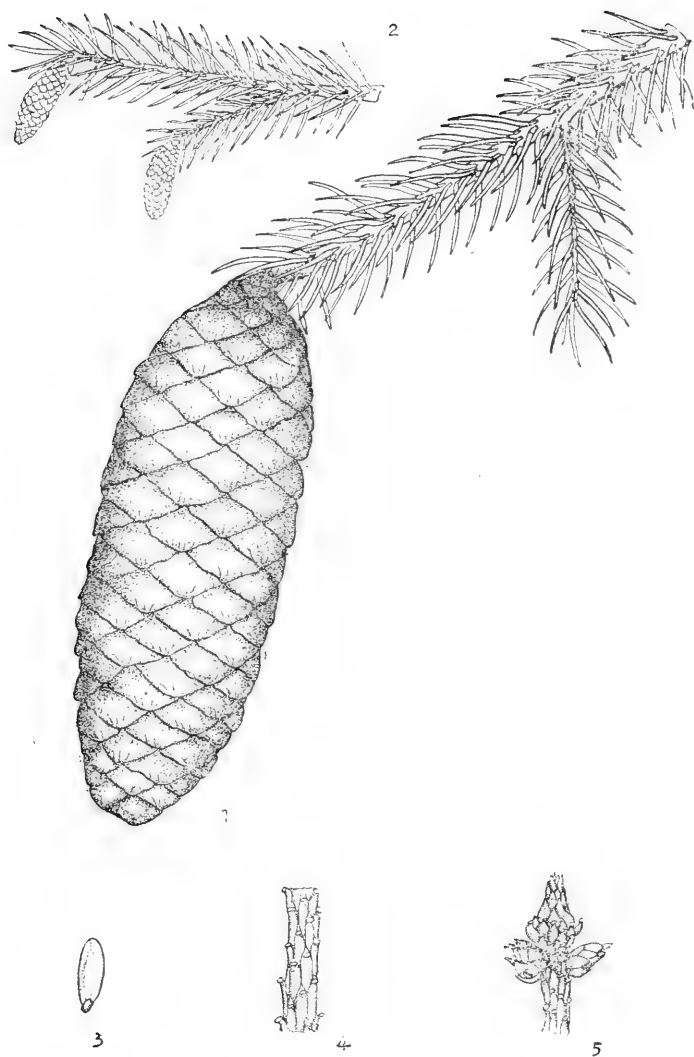
***Picea asperata* Masters.**

Tree to 35 m. tall of pyramidal habit with horizontal or somewhat pendulous branches up-turned at the ends and grayish-brown bark peeling off in thin, irregular flakes. Branchlets pale yellow-gray; winter buds resinous, conical with loosely appressed thin scales, spreading or slightly recurved, at the apex. Leaves pointing forwards, quadrangular, curved, acute with white stomatiferous lines on all 4 sides, 12 mm. long or slightly longer. Cones from 8-12 cm. long, cylindric oblong, pale yellow-gray at maturity, later becoming brown; cone scales closely appressed before time of ripening, very variable in shape, rounded, rhombic or even truncate at the apex. The cones remain on the tree 5 or 6 months after the seeds are shed. Seeds winged.

W. China.

A very valuable timber tree often forming extensive forests in W. Szechuan. In appearance *Picea asperata* can with difficulty be distinguished from *P. abies* Karsten, the widely distributed European species, and their distinction is not always certain even when herbarium specimens are compared. Rehder and Wilson have attempted to distinguish 2 varieties of this species, namely: *var. notabilis* with rhombic ovate scales narrowed to the apex, and *var. ponderosa* with longer cones, but intermediate forms in abundance indicate the inconstancy of these characters and the varieties may well be disregarded.

The wood of this species is similar to that of the European species and is used for general construction.

Plate 6. *PICEA ASPERATA* Masters

1. Fruiting branch; 2. Flowering branch; 3. Seed; 4. Twig showing sterigmata; 5. Buds.

***Picea montigena* Masters.**

Tree to 33 m. tall. Branchlets pale brown, hairy. Winter buds ovoid, acutish, resinous. Leaves quadrangular, curved, acutish, shiny green and somewhat glaucous, about 12 mm. long. Cones shiny red-brown, cylindric, 8-10 cm. long with rounded or truncate scales. Cones remain on the tree fully a year after seeds are shed.

W. China.

***Picea brachytyla* Pritzl.**

Tree to 22 m. tall. Branchlets yellow-brown, nearly glabrous. Leaves straight, acutish, compressed, whitish above, 12-15 mm. long. Cone cylindric, 7-9 cm. long; scales obovate, entire. Seeds winged.

W. China.

***Picea aurantiaca* Masters.**

Tree to 25 m. tall. Bark light gray. Branchlets orange, glabrous. Leaves quadrangular, 15 mm. long. Cones 11-12 cm. long, brown, subcoriaceous, broad, rounded.

W. Szechuan.

A species of restricted distribution, probably best regarded as a mere form of *P. schrenkiana*.

***Picea neveitchii* Masters.**

Tree to 15 m. tall. Branchlets shiny yellow-brown. Leaves about 15 mm. long, quadrangular, pointed. Cones 13-14 cm. long, oblong-cylindric, narrowed at both ends; scales oblong or suborbicular, entire. Seeds 25 mm. long, winged.

Rare tree in Hupeh. Mr. Wilson encountered only a single tree of this species. Seems to be closely allied to *P. polita* of Japan.

***Picea retroflexa* Masters.**

Tree to 45 m. tall. Bark gray, peeling off in flakes. Branchlets yellow to dull orange, glabrous, rarely slightly pubescent. Leaves quadrangular, stomatiferous on all 4 sides, 1-2.5 cm. long, sharp pointed. Cones shiny brown, symmetrical, 8-12 cm. long; scales obovate, rounded, striated, stiff. Seeds winged; wing 1.5 cm. long, oblique, oblong-obovate.

West Szechuan, may be only *P. asperata*.

Picea shrenkiana Fisher & Meyer.

(*Picea watsoniana* Masters)

Tall pyramidal tree. Branchlets pendulous, glabrous, ashy gray. Buds ovoid, light brown. Leaves quadrangular, 2-4 cm. long, dull green, acute. Cones 8-10 cm. long, cylindric-ovate with entire scales, shiny brown; scales obovate, cuneate with entire margins.

Siberia to N. China (Kansu to Chihli). A hardy species common within its range.

Picea purpurea Masters.

Tree to 20 m. tall, pyramidal when young, becoming irregular with massive horizontal branches at maturity. Bark dark gray, peeling off in regular flakes. Branchlets orange-yellow. Winter buds ovoid. Leaves more or less compressed with 2 white lines above, green beneath, curved, somewhat blunt, 8-12 mm. long. Cones purple, cylindric-oblong, 5-6 cm. long; scales rhombic to oblong, abruptly narrowed above the middle with acute or truncated apex.

The wood is brownish, close-grained and resinous; used for construction. The purple cones make this a distinct as well as handsome species.

Szechuan & Kansu.

Picea likiangensis (Franchet) Pritzel.

Tree to 25 m. tall. Branchlets yellow-gray, slightly hairy. Leaves quadrangular, slightly compressed, prominently keeled with 2 white lines above, 12 mm. long. Cone about 5 cm. long, brownish yellow with flexible rhombic-ovate scales, denticulate or slightly wavy margined above the middle.

Rarely this tree attains 35 m. tall in favorable situations. The flexible scales are horizontally spreading when the cone is ripe.

Szechuan & Yunnan.

Picea glehnii Masters.

A dense, low tree with spreading red, hairy or shaggy branches. Buds subglobose, resinous, brown. Leaves crowded, ascending, curved, linear, quadrangular, acute, green, the curved surface glaucous. Cones

2.5-5 cm. long, oblong cylindric or ovate oblong; scales leathery, striated, light brown, cuneate, rounded above and denticulate. Seeds up to 1 cm. long with an obliquely obcordate, membranous, pale brown wing.

Formosa, Sakhalin and Manchuria.

The following species that have been proposed require additional study:—

Picea gemmata Rehder & Wilson.

Picea wilsonii Masters.

Picea meyeri Rehder & Wilson.

Picea heterolepis Rehder & Wilson.

Picea balfouriana Rehder & Wilson.

Picea hirtella Rehder & Wilson.

Picea ascendens Patschke.

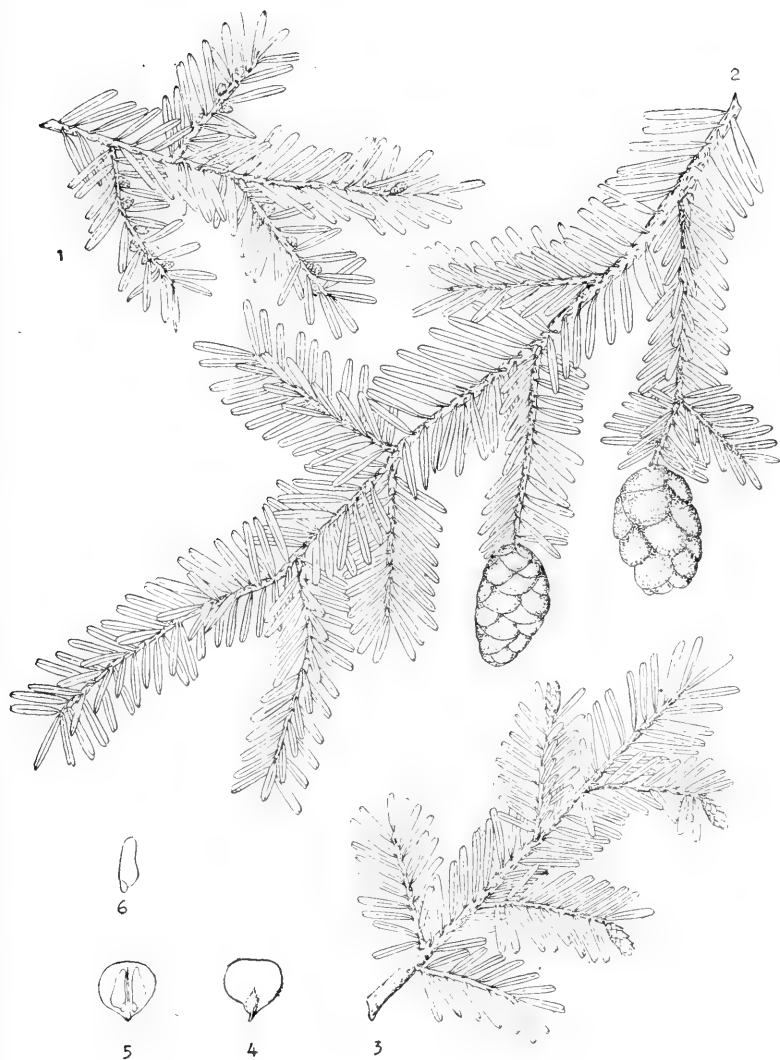
Picea complanata Masters.

Picea sargentiana Rehder & Wilson.

TSUGA

Resinous, evergreen trees with reddish bark and slender often pendulous branches. Leaves flat or angular, short, linear, set closely together, in 2 ranks (except in 1 species), stomatiferous on the under surface, short petioled and falling off upon drying. Staminate flowers solitary, axillary, globose, composed of numerous anthers with knob-like connectives. Pistillate flowers terminal, erect, with circular scales each bearing 2 ovules at the base; bract about as long as the scale. Fruit a small cone, oblong-ovate, pendulous, nearly sessile, greenish or purplish, turning brown at maturity, with persistent-flexible scales, longer than the bracts. Seeds nearly surrounded by the obovate-oblong wing.

Nine to ten species in Asia, N. America and the Himalayas. *Tsuga* is the Japanese name of the tree. The hemlocks are graceful, ornamental trees with the bark very rich in tannin, extensively employed in the United States of America for the curing of hides. The wood is coarse and brittle, of generally poor quality, but manufactured into coarse lumber, the best and most valuable being the W. American species, *Tsuga heterophylla*. The Japanese species, *T. sieboldii*, is said to be durable and is manufactured into lumber for the construction of houses. The hemlocks are slow growing trees, thriving best on well drained soil in regions of abundant rainfall.

Plate 7. *TSUGA CHINENSIS* Pritzel

1. Staminate flowering branch; 2. Fruiting branch; 3. Pistillate flowering branch; 4. Scale; 5. Scale and seeds; 6. Seeds.

***Tsuga chinensis* Pritzel.**

(Tieh Sha.) Iron Fir.

Small tree, rarely 40 m. tall, with yellow-gray, more or less pubescent branchlets. Leaves from 10–28 mm. long, rounded and notched at the apex, dark glossy green above, paler with 2 white bands beneath and with minute teeth on the margin when young, becoming smooth and green on both surfaces with age. Cones sessile, 15–30 mm. long, with shiny, brownish scales.

Hupei, Szechuan, Shensi.

This is the common Hemlock in Central and Western China. The wood is soft but durable, and is made into shingles. Closely allied to the Japanese *T. diversifolia*.

***Tsuga yunnanensis* (Franchet) Masters.**

Tree to 30 m. tall, with grayish and hairy branchlets. Cones with fewer scales. Leaves not notched at the apex, white on the under side.

Known only from Yunnan and Szechuan. It occurs on Omei Shan.

PSEUDOTSUGA

Large, pyramidal evergreen tree with deeply furrowed bark and whorled branches. Winter buds acute, elongated, not resinous. Leaves more or less 2 ranked, linear, flat, grooved on the upper surface with numerous rows of stomata on each side of the midrib beneath; with only 1 fibro-vascular bundle. Flowers solitary; the staminate oblong-cylindrical with numerous globose anthers having spur-like connectives; pistillate with spirally arranged scales, shorter than the pointed bracts. Cones pendent, ovate oblong, ripening in 1 season with woody persistent rigid scales shorter than the awn-pointed bracts. Seeds nearly triangular, winged.

4 species—2 in N. America, 1 in Japan and 1 in China. *Pseudotsuga* closely resembles *Abies* from which it may be distinguished by the elongated, non-resinous winter buds, by the slender, more flexible leaves and by the pendent cone which appears bristly on account of the exerted, 2 lobed, long and awned bracts. From *Tsuga* it is distinguished by the smooth twigs not roughened by persistent leaf bases. The common

American species *Pseudotsuga mucronata* is the most important timber tree on the Pacific Coast of N. America and it may be worthy of introduction into temperate parts of China for extensive cultivation as a timber tree.

***Pseudotsuga sinensis* Dode**

Tall tree with deeply furrowed bark and pubescent branchlets. The leaves are emarginate at the apex. Cones about 5 cm. long.

S. W. China.

KETELEERIA

Evergreen tree of pyramidal habit when young, in age with wide-spreading, massive branches, forming an irregular flat-topped tree. Bud not resinous, with numerous imbricated scales as an enveloping sheath at its base, after the branchlet has developed. Branchlets smooth. Leaves in 2 ranks by the twisting of the leaf bases, flat, linear, acute, green, keeled and not grooved on the upper surface, with a narrow stalk contracted to a circular disk at the base. Flowers monoecious. Staminate flowers in clusters, each flower composed of numerous 2-celled anthers on a stipitate axis. Cones erect, maturing in 1 year with upright, persistent scales woody in texture. Scales laciniate. Seeds 2 to a scale, with hatchet-shaped wings, as long as the scale.

A genus containing 2 species in China, differing from *Abies* by the clustered staminate flowers, by the cone with persistent scales and by the leaves, which are keeled or ridged on both surfaces and not depressed above. From *Pseudotsuga* it is distinguished by the erect cone and clustered staminate flowers.

Superficially the leaves of *Keteleeria* resemble those of *Cephalotaxus* but when the leaves of *Keteleeria* fall they leave a circular flat or slightly concave scar, the bark becoming scaly in the second year, while in *Cephalotaxus* the leaf scars are smaller, oval or irregular in outline and the elongated bark-like leaf bases persist as a covering of the twigs until the third or fourth year. *Keteleeria* is chiefly valuable as an ornamental tree and is planted in China near wayside shrines and tombs. The wood is locally useful. Propagated by seeds and cuttings. Cultivated in Europe and America.

***Keteleeria davidiana* Beissner.**

Tree sometimes 35 m. tall, with dark gray, irregularly fissured bark. Young branches slender, gray, glabrous or tomentose, or sometimes with short stiff hairs. Leaves 2-5 cm. long, rounded, notched at the apex, glossy green above, with stomatiferous lines and 2 green bands beneath, midrib raised on both sides. Cones cylindrical, oblong, on spur-like lateral branchlets, 5-20 cm. long, averaging 10-15 cm. long, reddish when young, turning green and finally brown at maturity. Cones scale ovate with a rounded or slightly truncated and reflexed apex, exposing the tip of the wings.

Shensi, Hupeh, Szechuan, Yunnan.

This is the most widely distributed species in China, occurring at an elevation somewhat less than that occupied by the firs and spruces. In a wild state it shows considerable variation in leaf and cone. The wood is soft, close grained, light, resinous and easily worked. It is used for the construction of houses.

Keteleeria evelyniana Masters may be identical with or at most only a form of the above.

***Keteleeria fortunei* Carriere.**

Tree to 30 m. tall with thick, rugged bark and spreading, horizontal branches. Branchlets glabrous, orange-red. Buds small, ovoid, orange-brown. Leaves appearing 2 ranked by the twisting of their petioles, linear, rigid, mucronate or spine-tipped, dark shiny green, keeled above with 2 stomatiferous lines beneath; 2.5-3 cm. long. Cones variable in size, ovoid or ovoid-cylindric; scales suborbicular; bracts half as long as the scales, mucronate tipped. Cones at first purplish, becoming brown with age. Seeds angular and wedge-shaped with a relatively broad, rounded, oblong wing.

S. E. China: Hongkong, Yunnan, Fukien. Characterized by orange-red, glabrous branchlets and purplish cones which become brownish at maturity.

The cones of this species are smaller and more globose than those of the preceding species.

ABIES

Evergreen trees with smooth or thick furrowed bark, and spreading, horizontal branches in whorls of 4 or 5 or more. Leaves linear, flat,

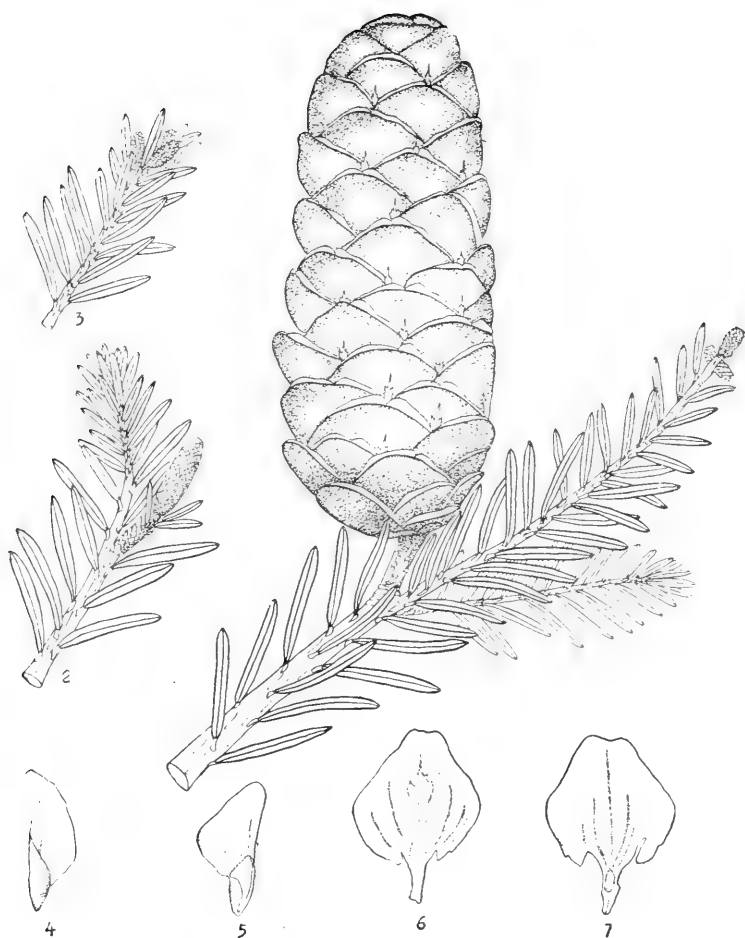


Plate 8. *KETELEERIA DAVIDIANA* Beisner

1. Fruiting branch ; 2. Pistillate flowering branch ; 3. Staminate flowering branch ; 4. Seed ; 5. Reverse of seed ; 6. Back of scale ; 7. Front view of scale.

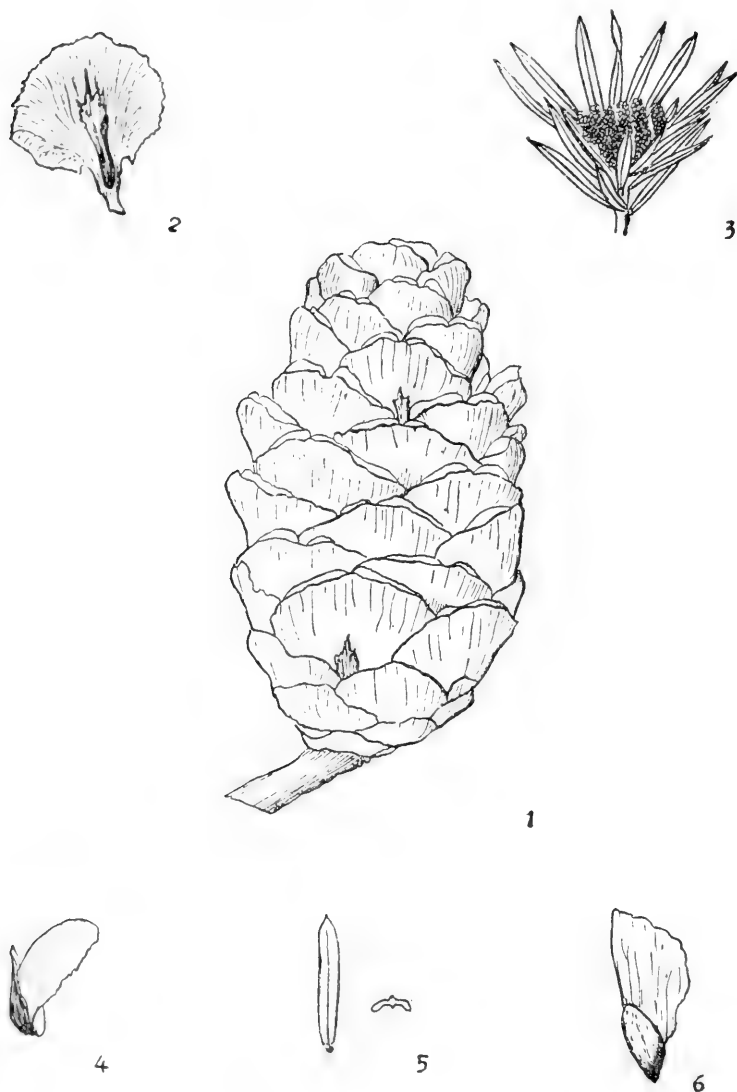


Plate 9. *KETELEERIA FORTUNEI* Carriere

1. Cone; 2. Cone scale; 3. Staminate flowers; 4. Side view of scale;
5. A leaf and its cross-section; 6. Seed. (After Beisner).

rounded, notched or pointed at the apex, sessile, green and seldom stomatiferous, grooved on the upper surface, silvery white beneath, spirally attached, though on horizontal branches apparently arranged in 2 ranks due to the twisting of their bases, in the upper fertile branches crowded and more or less projecting from all sides, persistent usually for 3 or 4 to 8 or 10 years, and in falling away, leaves flat circular scars on the twigs. Flowers axillary, appearing in the spring; the staminate aments pendulous, numerous, on the lower side of the branches, oval or cylindrical, with yellow or scarlet 2-celled anthers surmounted by a knob-like connective. Pistillate flowers usually on the topmost branches of the tree, erect, ovoid, with numerous imbricated scales, each with 2 ovules at the base. Fruit a cone, ovoid cylindric, the scales shorter or longer than their mucronate bracts, deciduous with the seeds, leaving the central axis of the cone persistent on the tree. Seeds with an oblique, dilated wing. Cotyledons 2.

About 25 species in the cool regions of the N. Temperate zone; about 4 well defined species in China. The genus is characterized by linear leaves which leave smooth circular scars on the twig when they fall, and by an erect cone whose scales are deciduous at maturity. Firs often attain great size and frequently form extensive pure forests. The wood is soft and brittle, of less economic value than those of the spruces and pines. Propagated by seeds. The seeds are not as viable as those of the pine, and can not be kept for more than 1 or 2 years. In nursery plantations, the seedlings are usually protected by half shade. The fir will undoubtedly take an important place in the reforestation of China, and in this connection the European species *Abies picea* is worthy of experimentation.

***Abies delavayi* Franchet.**

(*A. fargesii* Franchet)

(*A. faxoniana* Rehder & Wilson)

A tree 7-15 m. tall, with red-brown and usually shining shoots. Leaves light green and generally obtuse; sometimes notched at the apex, the margins usually rolled back towards the midrib below so as to form in cross section a figure 8. The cones are purplish, oblong-ovoid to oblong-cylindrical, broadest at the base, but slightly tapering towards the apex, from 7-11 cm. long and 3.5-5.5 cm. wide, averaging about 7 or 8 cm. long. The bracts are oblong-spatulate with a short abrupt point usually projecting beyond the scale.

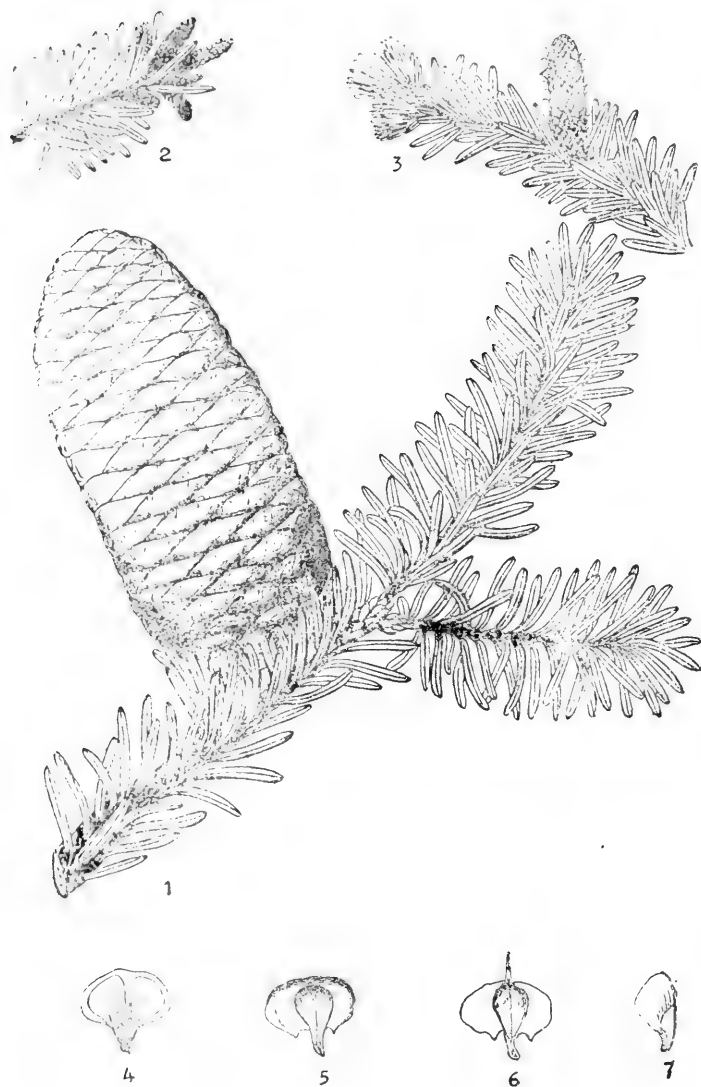


Plate 10. *ABIES DELAVAYI* Franchet

1. Fruiting branch; 2. Staminate flowers; 3. Pistillate flower; 4. Scale with seeds; 5, 6. Scales; 7. Seed.

Szechuan, Yunnan and Hupeh.

The specific characters upon which *A. fargesii* and *A. faxoniana* are founded are not sufficiently distinct and constant as to support recognizable species. In *A. delavayi*, the branchlets, leaves and cones show a range of variation which covers the difference ascribed to *A. fargesii* and *A. faxoniana*.

This tree forms extensive forests in the inaccessible regions of W. Szechuan and W. Hupeh, and evidences indicate that at one time, it occurred in great abundance over an extensive range. The tree attains a large size, and for this reason the timber finds its way into the market, although the wood itself is poor in quality. The wood is white, light, soft and not durable, used for interior finish and house construction and for the cheaper grades of coffins as well as for a variety of household purposes.

***Abies recurvata* Masters.**

Tree 16-25 m. tall, with reddish brown bark and shiny yellow-gray branchlets. The leaves are crowded, ascending and strongly recurved, shining green or glaucous on the upper surfaces, 10-12 mm. long, 2-3 mm. wide. Cones clustered, short stalked, oblong ovoid, 5-9 cm. long, violet-purple when young, gray-brown at maturity. The bracts are inclosed.

W. Szechuan in the Ming valley.

The recurved, sharp pointed leaves separate this from all other firs. It is confined to the mountains of the Ming River valley between Mao Chan and Sungpan Ting where it forms pure forests. (Wilson). The wood is fairly close grained and easily worked, used for house construction. On young shoots and vigorous branches the leaves are very sharp pointed and twice the normal length.

***Abies squamata* Masters.**

Tree 15-38 m. tall. Bark brownish purple, exfoliating or peeling in thin papery layers. Leaves crowded, spirally arranged, short and broad, acute or obtuse, more or less pubescent, 11-20 mm. long, 2 mm. wide. Cones 5-6 cm. long, oblong ovoid, violet-purple, resinous.

W. Szechuan and Tibet.

This fir forms pure stands and attains the highest altitude of any Chinese fir. It is easily distinguished by its purplish bark which peels off in thin strips. The wood is of good quality, used by the Tibetans for the construction of their houses.

***Abies chensiensis* Van Tieghem.**

Tree 15-40 m. tall. Shoots pale yellow-gray. The leaves are long, shiny green, arranged in one plane, blunt or slightly notched at the apex, very unequal in length on the same shoot, pubescent. Cones 8-10 cm. long, ovoid cylindric, pale brown, with larger thin scales. Seeds obovoid, 1 cm. long, wing about 2.5 cm. long.

W. Hupeh and Shensi.

This tree is comparatively rare. The cone with brownish and broad, thin scales is very distinctive.

***Abies beisneriana* Rehder and Wilson.**

Tree to 60 m. tall with gray-brown fissured bark and pale gray branchlets. Leaves ascending, flat, sharp pointed, the midrib slightly depressed above, pale green and glaucous below. Cones purplish when young, later gray-brown, small, 5-8 cm. long; scales thin and broad.

W. China.

The wood is soft and poor in quality. This may be only a form of *A. chensiensis*.

CUNNINGHAMIA.

Evergreen trees with whorled or irregular branches, and whorled or nearly opposite branchlets. Leaves linear, lanceolate, acuminate, rigid, more or less curved, sharply and minutely serrate, dark green above, pale green, with 2 stomatiferous bands below, narrowed at the base, densely and spirally arranged on the shoot, though appearing in 2 ranks owing to the twisting of their base. Flowers monoecious, clustered at the ends of the branches. The staminate flowers cylindrical, surrounded at the base by several imbricated scales, each flower composed of numerous spirally arranged stamens, each bearing 3 pendent, 1-celled anthers at the lower margin of an ovate, serrulate, scale-like connective. Pistillate flower globose, composed of imbricated scales, of which only the upper

ones are fertile; ovules 3 to each scale. Fruit an ovate cone with closely imbricated, coriaceous, brownish scales, serrulate at the margin and slightly reflexed at the apex. Seeds narrowly winged, 3 to each scale.

2 species, 1 in China, the other in Formosa.

Cunninghamia occurs in all the temperate parts of China at an elevation below that occupied by the spruces and the silver firs.

***Cunninghamia lanceolata* Hooker.**

(Sha Shu.)

A tree of pyramidal habit with scaly, brownish outer bark and red inner bark. Branches horizontal, short and spreading. Leaves linear, acuminate, 2.5-5 cm. long. Cones 2.5-5 cm. long, persistent on the tree 1 or more years after the seeds are shed.

Kiangsi, Kiangsu, Hupeh, Szechuan, Yunnan, Hunan, Fukien, Kwangtung.

Cunninghamia is mentioned in the earliest Classics, and in times past, has been considered the most valuable tree. Extensive forests still exist in the interior of Fukien and Hunan, as vast quantities of logs of this tree are floated down the rivers for export. E. H. Wilson reports several large forests of this species in western Szechuan. In the Chien Chang Valley in Szechuan, logs of the *Cunninghamia* buried by an earthquake about two hundred years ago, have been uncovered and sawn into planks, and the lumber, which is reddish brown, fragrant, fine grained and durable, commands a high price in the markets under the name of "Hsiang Mu," used for the manufacture of the highest grade of coffins. The wood of living species is light, soft, fragrant, easily worked, employed for every purpose for which great strength is not required. The wood has a broad sap wood and dark yellow heart wood. It is used for house building, general carpentry, for making tea chests, for pillars and masts and for boat building and a great variety of local uses. *Cunninghamia* reproduces freely from suckers, and the sprouts which spring from the stumps of felled trees grow rapidly into tree size, a feature which renders this species particularly adaptable to coppice management. *Cunninghamia* may prove to be the leading coniferous species in the reforestation of China.

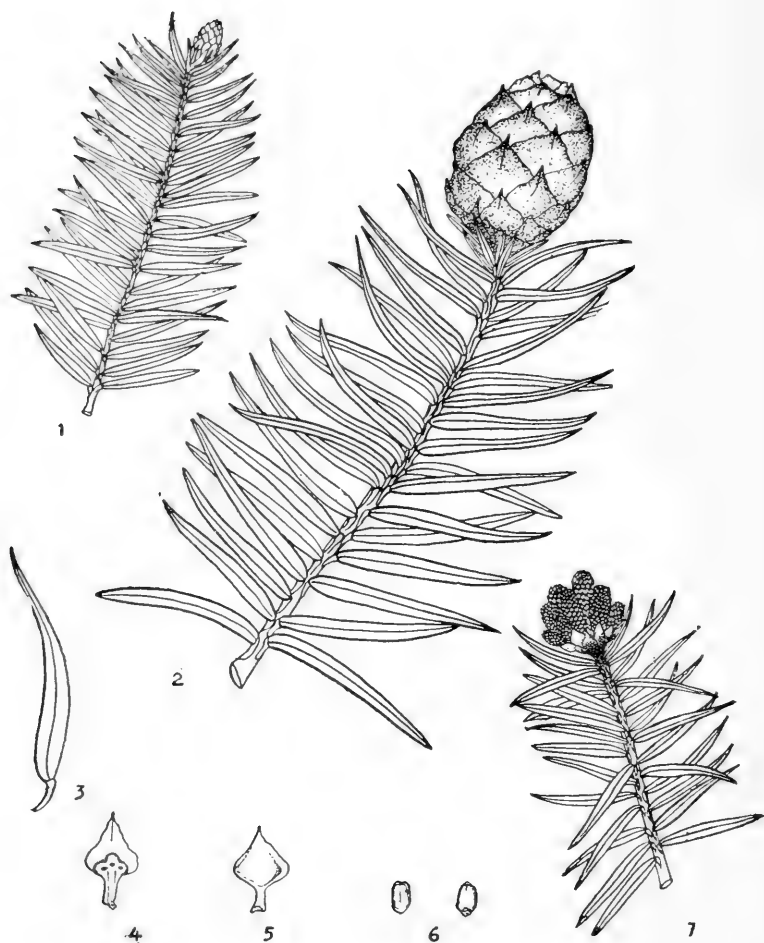


Plate 11. *CUNNINGHAMIA LANCEOLATA* Hooker

1. Pistillate flowering branch; 2. Fruiting branch; 3. Leaf; 4, 5. Bracts of scales; 6. Seeds; 7. Staminate branch. (Enlarged).

CRYPTOMERIA

Evergreen trees with spirally arranged, awl-shaped leaves, broad and sessile at the base. Flowers monoecious. Staminate flowers in numerous spike-like clusters, composed of imbricated stamens with pointed connectives and 3-5 pollen sacs to each scale. Pistillate flowers solitary, lateral on the branchlet, a globose conelet composed of spirally arranged, imbricated scales, with 3-5 ovules on each scale. The fruit is a globose cone with brown, peltate scales furnished with recurved bracts on the outer surface, and 3-5 sharp points on the top; each scale bears 3-5 narrowly winged seeds.

1 species in China and Japan.

This tree merits extensive planting for the purposes of afforestation and reforestation. An ounce of seed contains about 50,000 seeds. One pound will sow an area of seed bed about 100 feet square. The seedlings should be given half shade for the first year, and twice transplanted in the nursery before setting out in the field.

***Cryptomeria japonica* D. Don.**

Peacock Pine. (Kung Chiao Tsung.)

Tree sometimes 45 m. tall with cinnamon-red bark, peeling in long, thin shreds. Leaves persistent for 4 or 5 years, acute, 5 ranked, directed forwards, laterally compressed and keeled. Cone small, matures the first year, and remains on the branch one or more years after the seeds are shed.

China: Kiangsi, Hupeh, Szechuan, Yunnan, Chekiang, and Fukien.

Robert Fortune, in 1849, encountered this tree wild in the mountains near Ningpo, growing in company with *Cunninghamia*, and authorities believe it may still be found growing spontaneously in the mountains of Chekiang and Fukien, but it is now most commonly seen as a cultivated tree. *Cryptomeria* is the largest, the most useful and the most commonly planted timber tree in Japan, imparting a characteristic feature to her landscape. The tree is rapid growing, attaining a large size, specimens measuring 150 feet high are not rare. It has a pale sap wood, dark, reddish heartwood. The wood is devoted to many uses, the principal ones being for bridge, house and ship building. The bark is used by the Japanese peasants to shingle the roofs of their houses. From the leaves an essential oil may be extracted.

GLYPTOSTROBUS

Included by some authors under *Taxodium* to which it is closely allied. The leaves, together with the short annual shoots, are deciduous, and the cone scales are deciduous as well, whereas in *Taxodium* the cone scales are persistent. *Taxodium* is now confined to N. America and Mexico, but at former geologic periods, widely distributed in N. America and Europe.

Glyptostrobos heterophyllus Endlicher

(*Taxodium heterophylla*)

Swamp cypress; "Water Pine."

Is a shrub about 3 m. tall, confined to swampy lowlands in S. China.

LIBOCEDRUS

Evergreen, resinous, aromatic trees with naked buds and scaly bark. Branchlets flattened, frond-like. Leaves scaly, in 4 ranks, more or less compressed, with or without glands. Flowers monoecious or dioecious, solitary, terminal; staminate oblong, composed of 6-8 pairs of stamens each bearing 4 subglobose anther cells; pistillate oblong, composed of 3 pairs of scales, subtended by several bracts which are persistent in the fruit. Fruit maturing in 1 year, an oblong-ovate cone consisting of 6 scales, the lower and the middle pairs spreading at maturity; the third pair united to form a woody septum. Seeds winged, 2 in each fertile scale.

8 species in W. N. and S. America, Australasia, Formosa and S. China.

In America *Libocedrus* is known as Incense Cedar on account of its aromatic resinous property. The following is the only species known in this country.

Libocedrus macrolepis Benthams and Hooker.

Tree to 33 m. tall. Branchlets compressed, green on both sides. Leaves acute, the lateral pair strongly keeled, the middle ones obovate, apiculate. Cones obovate-oblong, composed of 6 scales about 2.5 cm. long.

S. W. China.

The wood is straight grained, fragrant and durable.

THUJA

Evergreen, resinous, aromatic trees with much-ramified spreading branches and flattened branchlets arranged in a horizontal or vertical frond-like spray. Leaves decussate (in alternate pairs), in 4 ranks,

scale-like, small and usually glandular on the back; those on the leading shoot pointed and more or less spreading; on less vigorous shoots, rounded and much compressed, the lateral pair nearly covering the dorsal and ventral pair which are flattened. The leaves of juvenile plants and of some species and forms are not scale-like but uniformly awl-shaped, pointed and spreading. Flowers monoecious, solitary and terminal; the staminate small, globose or cylindrical, composed of 3-6 stamens, each bearing 2-4 pollen cells on an orbicular connective. The pistillate flowers are minute cones, composed of 4-6 pairs of scales, not all of which are fertile, the fertile ones bearing 2-3 ovules each inside at the base. Fruit a small ovate or oblong cone with leathery scales and usually 2 seeds to each scale. Seeds small, usually winged.

About 5 species in Central and Eastern Asia and North America. *Thuja*s may be distinguished from the flat-leaved cypresses by the cones, which in the latter genus are usually globular in form and composed of dilated or peltate scales, attached by the middle and in contact with each other on the perimeter before the seeds are liberated.

The *Thuja*s are evergreen trees of generally pyramidal habit planted mainly for their ornamental value. Numerous horticultural varieties have been developed. Propagated by seeds; the varieties by cuttings. The genus is divided into 2 sections, in China each section is represented by 1 species.

Thuja orientalis* Linnaeus.

(Poh Shu.)

A pyramidal tree 10 m. tall, or a dense, bushy shrub with thin, reddish bark scaling off in thin, papery layers and upright or ascending branches, bearing the much ramified sprays in a vertical plane. The leaves are green on both sides, marked by a glandular depression on the back; the leaves of the frond-like spray are closely appressed to the slightly flattened axis; those of the more or less rounded lateral or main axes are rhombic-ovate, with a free, acute and somewhat reflexed apex. The cone is ovate-globose, erect, fleshy, bluish, later becoming hard and woody, 12-25 mm. long; scales with a hooked spine on the outer surface below the top, usually in 3 pairs, the upper pair sterile; the fertile scales each bear 2 seeds. Seeds large, round and without wings.

*See Frontispiece.

Native of N. E. China, elsewhere cultivated. Introduced into Japan. The *Poh shu* of the classics is referable to this species. In bygone days the tree distinguished the gardens of the princes and sheltered the tombs of rulers. To-day it is most commonly met with in gardens and burying grounds. Throughout the New Year festivities, sprays of this fragrant evergreen are used to symbolize long life and happiness. The fruit, leaves and inner bark all have medicinal uses.

Propagated by seeds. The number of seeds per pound is about 18,600, germination is rapid, most of the seeds coming up between 10 and 25 days.

***Thuja sutchuenensis* Franchet.**

A small tree in Eastern Szechuan characterized by thin, scaly, nearly glandless leaves or flattened branchlets, thin, leathery cones with 8 scales, somewhat thickened at the apex, and winged seeds produced only by the middle 2 or 3 pairs of scales.

FOKIENTIA

Trees, evergreen. Leaves small, scale-like on flattened, frond-like branch systems which may be described as tripinnately divided. The leaves are in 4 ranks, the lateral pairs narrowly keeled or clasping, the facial leaves flattened, acute or obtuse, with the bases narrowed or crowded by the lower parts of the lateral leaves. On young shoots the branchlets appear particularly flattened, the leaves are much larger (sometimes 8 mm. long), the lateral pairs with conspicuously long, free, sharp points and often marked on the under surface by conspicuous longitudinal glaucous areas caused by stomata. The foliage has a strong resemblance to *Libocedrus macrolepis*. The flowers are imperfectly known.

Female flower terminal, composed of 6 to 8 pairs of opposite, decussate, blunt-pointed scales, each scale with 2 ovules. Cones are said to ripen in the 2nd year. They are globular in general form, composed of 12 to 16 woody, peltate scales, each clavate or cuneate in shape, expanded into a mainly 2-lobed shield or apophysis with a minute mucro in the depressed center.

Seeds 2 to each seed-bearing scale, about 4 mm. long, 3 or 4 sided, flattened at the base and provided with 2 thin wings unequal in size.

While the foliage resembles *Libocedrus* the fruit has a general likeness to *Cupressus* or *Chamaecyparis*.

Only 2 species are known, *F. hodginsii*, Henry and Thomas, from Fukien and *F. kawaii* Hazata from Tonking.

Fokienia hodginsii Henry & Thomas

Tree to 12 m. tall. Cones 2.5 cm. long, subglobose. Fukien.

CUPRESSUS

Resinous, evergreen trees, rarely shrubs, with 4-angled or sometimes slightly flattened branchlets. Leaves of 2 kinds; on adult plants they are small and scale-like, in alternate pairs, and closely appressed to the twig; on juvenile plants and on vigorous shoots of adult plants, they are linear, lanceolate or awl-shaped, in whorls of 4, or sometimes ternate and spreading. Flowers minute, monoecious, terminal, yellow. The staminate flowers oblong, composed of numerous pairs of stamens, each with 2-6 pendulous pollen cells on the edge of an ovate connective. The pistillate flowers oblong or globose, composed of thick, decussate scales, the ovuliferous ones bearing one to several rows of urn-shaped ovules at their base. Fruit a globose cone, made up of woody, peltate scales furnished with a short, knob-like mucro. Seeds with 2 thin wings. *Cupressus* is usually biennial fruited.

A genus containing about 12 species, all in the warm temperate regions of the Northern Hemisphere. *Chamaecyparis*, a closely allied genus, placed by some botanists under *Cupressus* as a sub-genus, and hardly differing from *Cupressus* except in its smaller and usually annual fruit, of great economic importance in Japan, also found in Formosa, has not yet been reported from China, although its discovery there might not be an improbable result of extensive explorations. In Japan *Chamaecyparis obtusa* and *C. pisifera* are important silvicultural species. Morphologists detect no structural differences between the wood of *Cupressus* and *Chamaecyparis*. The 2 genera, *Chamaecyparis* and *Thuja*, yield the lightest of all merchantable woods in America.

Cupressus is easily distinguished from all nearly allied genera by the 4-angled branchlets with minutely denticulate leaves.

***Cupressus funebris* Endlicher.**

(Pe Hsa.) Funeral Cypress.

A tree up to 25 m. tall with smooth, reddish bark. When young, more or less compact in habit, in age with drooping branches and branchlets, and long, pendulous, flat sprays. The leaves are imbricated in 4 rows, ovate-deltoid, gray-green with pointed, free and slightly spreading apex. Staminate flowers yellow; stamens usually 8. Cones stalked, globose, 8-12 mm. long, brown, covered by a purple bloom; scales 8, with a pointed or knob-like process on the slightly depressed apex. Seeds usually 3 to each scale, slightly winged.

Chekiang, Anhwei, Szechuan, and Hupeh.

This tree is unique among conifers on account of its graceful drooping habit, and its decorative value has long been effectively utilized for ornamenting courtyards, tombs and shrines. The landscape effect produced by the weeping willow may also be achieved by the funeral cypress, and, in fact, some authorities maintain that the so-called willow pattern dishes, copied from Chinese design, portray the cypress rather than the willow. It is cultivated throughout Central China and it was early introduced into India by the Buddhist monks, where fine specimens are now growing in the vicinity of temples and monasteries. The wood is white, fairly hard, close and fine grained, tough and durable, one of the most valuable of Chinese timbers, used for general carpentry, coffins, furniture, agricultural implements, house construction and boat building. The cypress is a fairly rapid growing tree and often forms pure stands.

***Cupressus torulosa* Don.**

(Kan Pe Sha.)

Pyramidal tree about 45 m. tall with reddish-brown bark. Branches numerous, horizontal, spreading and ascending at the tips. Branchlets somewhat drooping, slender, quadrangular. Leaves dark green or sometimes bluish green, somewhat acute, keeled; the apex not thickened, appressed or very little spreading. Cones 1.2-2 cm. long, nearly sessile, with 8-10 scales armed with a blunt or inconspicuous horn or knob.

This species extends from the Himalayas to W. China. It once existed in extensive forests, but is now only met with as scattered specimens. The tree produces a high grade timber. *Cupressus torulosa* is a good tree to plant in the woodlot. It is also suitable for windbreaks and for planting in the garden as a single specimen.

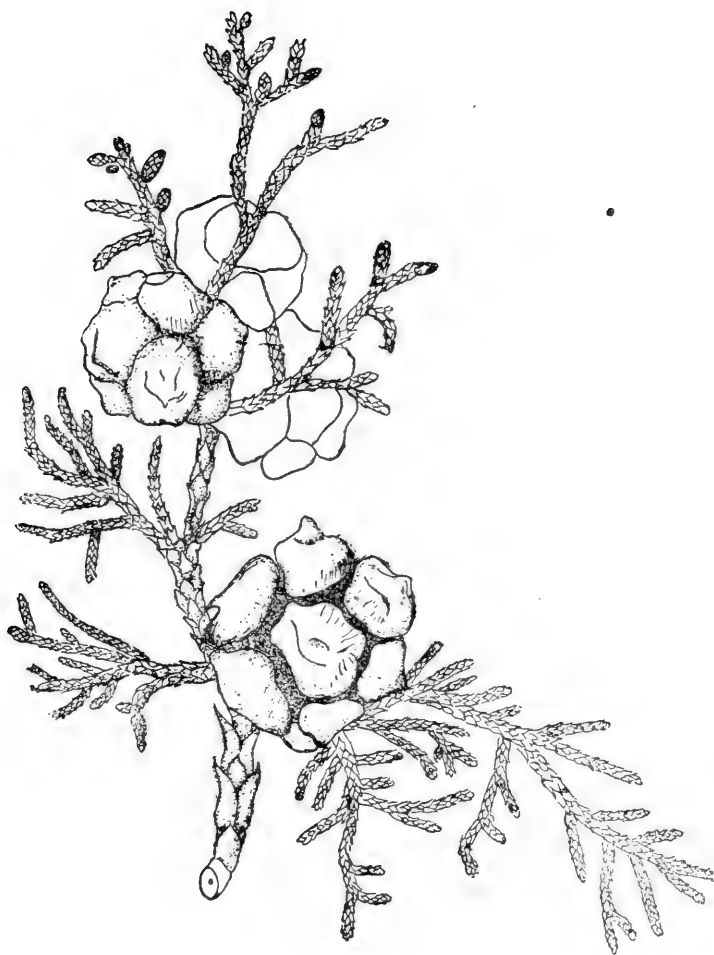


Plate 12. CUPRESSUS TORULOSA D. Don

JUNIPERUS

Evergreen, aromatic trees or shrubs usually with thin, shreddy bark. Leaves of mature plants acicular or awl-shaped, or short, scale-like and closely appressed, arranged in whorls of 3's or opposite. Leaves of seedlings and very young plants are always acicular or awl-shaped and diverging at a wide angle from the twig, vigorous or diseased shoots of scaly-leaved species also have acicular leaves in the juvenile stages. Flowers small, dioecious, rarely monoecious. The staminate flowers yellow, catkin-like, composed of numerous stamens, each bearing at the base, 2-6 pollen sacs. Pistillate flowers small, ovoid, greenish, composed of 3-6 pointed, fleshy scales which unite together to form a fleshy, berry-like fruit. The minute, ovuliferous scales are either borne on the inner surface of the fleshy flower-scales or alternate with them. The fruit is a short-stalked, berry-like strobile or cone, usually enclosing the seeds, 1-6, (rarely -12), subtended by several persistent scales at the base, ripening the 1st, 2nd, or 3rd year.

About 40 species in the N. Hemisphere. About 6 species in E. Asia. The junipers range from upright, pyramidal trees to low and sometimes prostrate shrubs. The wood is reddish, close grained, fragrant and durable, used for interior finish, for the manufacture of small articles and for posts and poles. The American *Juniperus virginiana* produces the bulk of the pencil wood. Several species yield a volatile aromatic oil, which since the days of the early Greeks and Romans has been employed in medicine as an ointment and also as a stimulant. Propagated by seeds which should be stratified for one year, as in most cases, they do not germinate until the second year. Also may be increased by cuttings and grafting.

Distinguished from *Cupressus*, to which it is closely allied, by the small, berry-like fruits, and by the leaves which are stomatiferous above, those of *Cupressus* being stomatiferous on the under surface.

***Juniperus chinensis* Linnaeus.**

(Tsze Poh,) Chinese Juniper

A very variable species, ranging from a low shrub to a tree 20 m. tall. Bark brown, peeling off in long, narrow strips. Branches without winter buds. Leaves dimorphic; on young plants and vigorous shoots acicular, 8 mm. long, in whorls of 3's or in pairs, spreading, sharp

pointed, with a ridge and 2 white bands on the back; on adult trees scale-like, in alternating pairs, rhombic-ovate and obtuse, or both scale-like and acicular. Staminate flowers bright yellow, numerous. Fruit globose, usually broadest and slightly depressed at the summit, brownish, covered with a white bloom, with resinous flesh from 5-8 mm. in diameter, 2-3, rarely more, seeded.

China, Mongolia and Japan.

Planted around temples and tombs, appearing wild in the mountains of Hupeh, Shensi and Szechuan. On the grounds of the Temple of Confucius is an avenue of large old trees. Extensively cultivated in Europe and America on account of its hardiness and indifference to soil.

Juniperus formosana Hayata.

Tree up to 16 m. tall with longitudinally fissured bark, dark brown in color, peeling off in thin strips, and ascending or spreading branches with more or less pendulous, 3-cornered branchlets, at first greenish, later turning reddish-brown. Leaves all acicular or awl-shaped, in whorls of 3's, spreading, variable in length, from 1.2-3 cm. long, sharp pointed, ridged at the back and with a broad, white line on each side of the ridge. Fruit ripening the second year, globose, or ovate, 6-8 mm. long, shining orange or reddish-brown, 3 seeded. Seeds 3-angled, slightly mucronate at the apex.

Widely distributed in the mountains of China, extending to Formosa. Also planted around temples. Hupeh, Szechuan, Shensi, Fukien, Chekiang, Hongkong.

TAXACEAE

Trees or shrubs with resin ducts in the bark. Leaves linear-lanceolate, spirally arranged, though appearing in 2 ranks by the twisting of the leaf bases. Flowers dioecious or monoecious, the male borne on more or less thickened scales, forming a small cone. The pistillate flowers consist of 1 or 2 ovules on a fleshy, rudimentary carpel, becoming a hard bony seed, more or less surrounded by a fleshy, often highly colored arillus or receptacle. Cotyledons 2.

About 11 genera and 100 species subdivided into 2 tribes, namely:—

Podocarpaceae, with winged pollen grains, chiefly confined to the Southern Hemisphere.

Taxineae, with wingless pollen grains, confined chiefly to the Northern Hemisphere.

4 genera occur in China.

KEY TO CHINESE GENERA

Podocarpaceae. Pollen grains winged; anthers 2 celled; trees and shrubs chiefly tropical and subtropical.

A. Leaves linear to elliptic, rarely scale-like; fruit usually on a thick, fleshy peduncle.....*Podocarpus*.

Taxineae. Pollen grains wingless; anthers 3-8 celled; trees and shrubs mostly in the temperate regions; leaves linear.

A. Pistillate flower composed of 2-20 scales on a fleshy axis, each scale bearing 2 ovules ripening into a more or less fleshy cone with few large, drupe-like seeds.....*Cephalotaxus*.

B. Pistillate flowers reduced to a solitary ovule.

I. Anthers 4 celled, united into a half ring; fruit a drupe with a long-pointed seed; leaves with 2 broad white lines beneath*Torreya*.

II. Anthers 6-8 celled, united into a globose head; fruit berry-like, composed of a bony seed surrounded by a colored fleshy aril; leaves pale green beneath*Taxus*.

TAXUS.

Evergreen trees or shrubs with dark, reddish-brown bark peeling in thin shreds when young. Leaves mostly in 2 ranks by torsion of the leaf bases, flat, dark green and keeled above, pale green beneath, pointed and stalked. Flowers dioecious, rarely monoecious, borne in the axils of the leaves on twigs of the previous year's growth. The staminate flowers consist of a globose head of 6-8 yellow stamens on a stalk with imbricated scales at its base; the stamens composed of 4-8 conical, pendent anther cells connate at the apex to each other and to their filament, spreading and shield-shaped after the discharge of the globular pollen grains. The pistillate flowers consist of a solitary ovule in the

TAXACEAE

axil of the uppermost of several imbricated scales. Fruit a bony nut in a fleshy, scarlet, cup-like disk, with the apex exposed and usually free from the cup. Cotyledons 2.

Distributed over the N. Hemisphere, extending over large portions of Europe, America and Asia. The 7 species described differ from each other only slightly in foliage and fruit, and botanists sometimes regard them as geographical variations of a single species. The most recent monographer of the genus, Pilger, grouped all the geographic forms under *Taxus baccata*. The yews are slow-growing evergreen trees with dark, glossy foliage and bright red, berry-like fruits. They are planted in gardens for ornamental purposes, and since the earliest times have been closely associated with the religious life of the English, Hindoos and the Chinese. In certain sections of China, the yew is known as "Kwan-yin Sha,"—the fir of the Goddess of Mercy. In the olden days, bows were almost exclusively made from the wood of the yew. The wood is reddish, strong and durable, formerly much prized for cabinet making and for interior finish. In India and China, the wood is used for incense. The leaves and shoots have a poisonous property which sometimes proves fatal to horses and cattle which browse upon them, but the pulp of the seeds, which is sweet and harmless, is edible. Propagated by seeds which should be stratified for 1 year as they do not germinate until the second year after sowing; also propagated by layers and cuttings.

***Taxus cuspidata* Siebold & Zuccarini.**

(*Taxus chinensis* (R. & W.) Rehder.)

(*Taxus cuspidata* var. *chinensis*. R. & W.)

Tree 6-15 m. tall, with brownish-red bark. Leaves usually falcate, dark green above, pale green beneath, abruptly pointed, 12-25 mm. long, rarely longer. Seeds ovoid, slightly 2-4 angled, with a minute point at the apex, flesh light red.

China, Korea and Japan.

China: Kansu, Shensi, Kweichow, Chekiang, Hupeh and Szechuan.

The Chinese tree cannot be distinguished from the Japanese type and the two should be regarded as identical. It is a comparatively rare tree in China, but occasionally a large specimen is met with in the mountains of Szechuan and Hupeh. Dwarfed forms variously trimmed and trained are under cultivation in the gardens of the wealthy.

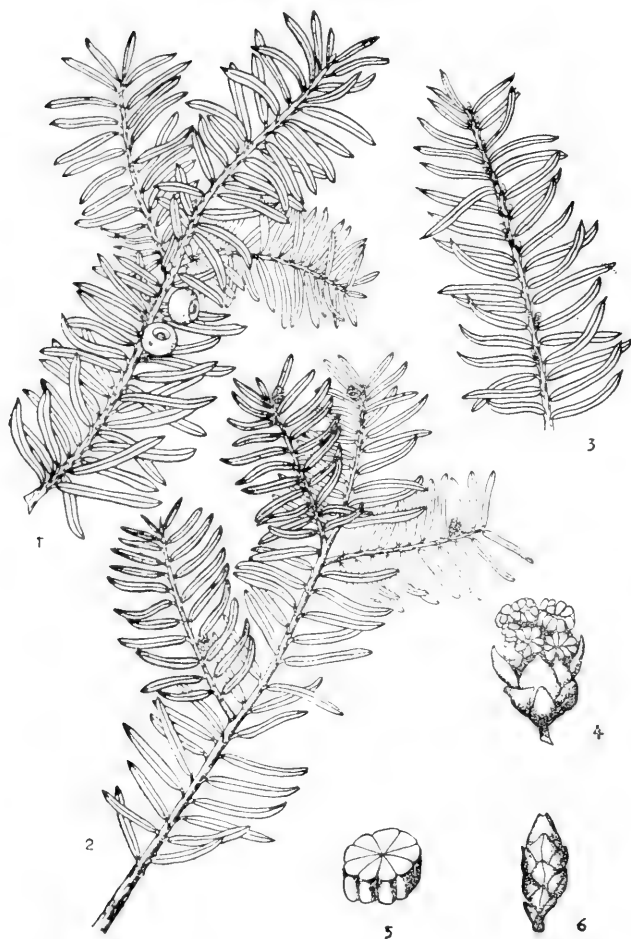


Plate 13. *TAXUS CUSPIDATA* Siebold & Zuccarini

1. Fruiting branch; 2. Staminate flowering branch; 3. Pistillate flowering branch; 4. Staminate flower; 5. A stamen; 6. Pistillate flower. (Details enlarged).

CEPHALOTAXUS

Trees or shrubs, with linear, flat leaves arranged in 2 ranks by torsion of the leaf bases. Flowers dioecious. The staminate, 6-11, in axillary, stalked clusters, subtended by imbricated scales; each flower in the axil of a membranous bract, consisting of 7-12 stamens each bearing 3-6 anther oells on the under surface of a short-stalked scale. The pistillate flowers consist of several small, stalked cones in the axils of bracts at the base of terminal shoots; the flower composed of 2-20 scales on a fleshy axis, each bearing 2 naked ovules, only 1 of which develops. At maturity the scales become fleshy and confluent, more or less enclosing the seeds. The seeds large, usually only few in each cone, drupe-like, with reddish-brown or greenish-brown, resinous husk and hard, woody shell. There are 6 closely allied species in E. Asia.

Cephalotaxus fortunei Hooker.

Tree 20 m. tall, of graceful habit, with long, slender branches. Branchlets yellowish green and pendulous. Leaves 5-7.5 cm. long, generally falcate, sharp pointed, dark green and lustrous above, pale green beneath. Fruit obovate, greenish-brown or purple.

China, Burma and Japan.

China: Kiangsi, Hupeh, Szechuan, Yunnan, Chekiang, and Shensi.

In China this tree is frequently planted near wayside shrines and temples.

Cephalotaxus drupacea Siebold & Zuccarini.

A shrub with stiff, spreading branches and leaves shorter than the preceding.

Central and Western China.

PODOCARPUS

Evergreen, resinous trees or rarely shrubs. Leaves alternate, rarely opposite, sometimes 2 ranked, linear, lanceolate or elliptic, sometimes small and appressed. Flowers usually dioecious, axillary or terminal, solitary or in spikes. The staminate flowers often cylindric, composed of numerous spirally arranged, imbricated scales, each bearing a 2-celled

anther on the under side; pollen grains with 2 large round wings. The pistillate flowers, usually solitary and pedunculate, consisting of a scale enveloping the single ovule, with several bracts at the base which become much thickened and more or less fleshy at maturity. Fruit a naked or fleshy and drupe-like seed, supported on a usually fleshy receptacle. Cotyledons 2.

About 50 species, mostly in Australasia, S. America, and Southern Asia and Africa. Members of this genus are tropical and only 1 species occurs in China. For the most part, they are important timber trees. The staminate flowers are yellow; the pistillate green. The fruit is small and berry-like, borne on a fleshy stalk which in some species is edible. Propagated by seeds and by cuttings.

Podocarpus nerifolia Don.

A tree, above 25 m. tall with whorled branches and thin, fibrous bark. Leaves scattered, sometimes in whorls of 3-5, narrow lanceolate, acute, margin somewhat revolute, midrib prominent on both sides, coriaceous, dark green above, slightly glaucous below, 13-26 cm. long. Staminate flowers 3-5 cm. long, sessile and clustered. Pistillate solitary, on a peduncle 12 mm. long. Receptacle fleshy, at first yellow-green, changing to orange-red and finally deep purple at maturity. Seeds ovoid, glaucous green, 12 mm. long.

From the Himalayas to S. W. China and New Guinea. E. H. Wilson notes that the tree is occasionally planted around temples in the warmer parts of Western Szechuan, particularly on Omei Shan. The fleshy receptacle of the fruit is eaten by the natives of Nepal. The wood is light, close and even grained, yellowish and fairly hard, much esteemed in Burma. This species is sometimes met with as a greenhouse plant in Europe.

TORREYA

Evergreen trees with more or less foetid or aromatic leaves, shoots and fruit. Buds with few bud scales. Leaves spirally arranged but appearing 2 ranked on the lateral branches, linear, sharp-pointed, slightly rounded and dark green on the upper surface, paler and with a groove and 2 narrow stomatiferous lines below, more or less foetid. Flowers dioecious, rarely monoecious. The staminate flowers solitary, in the axil of a leaf on the

previous year's growth, ovoid or oblong, composed of numerous stamens in whorls of 4 on a slender axis, surrounded at the base by several pairs of scales; the stamens consist of 4 pollen sacs united to form a half ring by a projecting connective. Pistillate flowers scattered, sessile, consisting of a solitary ovule surrounded at the base by a fleshy urn-like disk or arillus and several scales, becoming at maturity a drupe-like fruit with a long seed pointed at the apex, entirely covered by a fleshy husk.

4 species, 2 in E. Asia and 2 in N. America.

Torreya resembles the *Cephalotaxus* superficially, but they may be distinguished from each other by the leaves, which in *Torreya* are bristle pointed and marked by stomatiferous lines beneath, while in *Cephalotaxus*, the leaves are short pointed, and covered on the under surface by 2 broad stomatiferous bands. The buds of *Cephalotaxus* have numerous scales which persist at the base of the branchlet, while *Torreya* has fewer bud scales which are, for the most part, non-persistent. The drupe-like fruit separates this from all other evergreen trees. The wood of *Torreya* is pale yellow, handsome and durable in contact with the soil. It is used for furniture, house construction and for fence posts. The stumps of felled trees sprout freely. Propagated by seeds and cuttings.

***Torreya grandis* Fortune.**

(Fei Shu.)

Tree sometimes 25 m. tall, occasionally shrubby, and producing fruit when very young. Bark gray-green. The leaves and branchlets have a very slight, if any, disagreeable odor. Branchlets green, turning yellow-brown the following year. Leaves 12–25 mm. long, linear lanceolate, bright shiny green above, with 2 white bands beneath. Fruit ovoid or globose, 2–2.5 cm. long; husk without pungent odor. Nut reddish-brown, with irregular, shallow fissures on the surface.

Chekiang, Fukien, Hupeh, Szechuan.

Fortune first came upon fine specimens of this tree 25 m. tall, in the mountains above Ningpo in 1855, but it is now most commonly seen in its shrubby form. Although the seeds are said to have a purgative property, they are eaten when roasted and may be found exposed for sale in the markets. The medicine *Fei Shu* is derived from this nut.

This is the only species found in China, the other Asiatic species, *T. nucifera*, being confined to Japan.

CLASS II. ANGIOSPERMAE

SALICACEAE

Leaves alternate with stipules. Flowers dioecious, in catkins. Perianth absent. Stamens 2 to indefinite. Ovary 1 celled; styles 2. Capsule 2-4 valved. Seeds bearded, exalbuminous.

Two genera and about 200 species, of which *Salix* is the largest genus, with about 150 species. The family occurs in the N. temperate region, extending into the arctic circle. *Salix* is a most baffling genus to the systematic botanist because the trees are dioecious, and the species hybridize freely.

KEY TO GENERA

- I. Bracts of the flowers incised or fringed; stamens numerous; stigma elongated *Populus*.
- II. Bracts of flowers entire; stamens 2-10; stigmas short *Salix*.

SALIX

Trees or shrubs. Buds covered by a single bud scale, composed of 2 connate and coalescent stipules. Leaves deciduous, alternate, simple, stalked, mostly elongated and pointed, pinnately veined; stipules serrate, small and caducous, or large and persistent. Flowers dioecious, in catkins, without perianth, each subtended by a bract with usually entire margins, glandular. Staminate flowers with 2-12 stamens on slender filaments. Pistillate flowers with a single pistil; carpels 2; stigmas 2, entire or bifid. Fruit a capsule dehiscent on top into 2 valves. Seeds minute, dark brown or black, furnished with long, silky hairs.

About 150 species, mostly shrubs, widely distributed in the Northern Hemisphere, ranging in habitat from low wet ground to Alpine heights. The wood of the genus, for the most part light and soft, is chiefly useful for the manufacture of small ware and for burning for charcoal. Of the arborescent species, the widely distributed *Salix alba* and *Salix fragilis* are valuable timber trees, and the wood supplies the best charcoal for the manufacture of gunpowder. The branchlets of the willow are woven into baskets and furniture, and large plantations of the willow trees are expressly maintained as an adjunct to these industries.

Almost any species suitably treated will yield good material for baskets, but *Salix viminalis* and *Salix purpurea* are most commonly cultivated for this purpose. The cultivation of the willow should be encouraged in China in order to stimulate the basket and furniture weaving industry. But perhaps the most important use to which willows may be put is for soil cover—to hold river banks, to stop shifting sand and to prevent erosion on steep slopes. In Europe, *Salix daphnoides*, which extends from the Himalayas, through Northern Russia to Manchuria, is used to hold shifting sand and railway embankments, the strong and wide-spreading root system renders this species particularly suitable for the purpose. It may have a like value in China. The willows increase readily by seeds, but the quickest method of propagation is by cuttings. Shoots stuck in the ground in early spring soon root and begin to grow.

***Salix babylonica* Linnæus.**

Weeping Willow.

Tree 10–15 m. tall with short trunk, wide-spreading branches and long, pendulous, glabrous, olive green or purplish branchlets. Leaves 8–15 cm. long, linear lanceolate, tapering to a narrow point, cuneate at the base, bright shining green above, covered with a glaucous bloom beneath. Pistillate catkins about 3 cm. long, green, appearing with the leaves. Scale about $2/3$ the length of the ovary.

This tree is found wild in the western provinces of China. It was early introduced into Europe, now it is everywhere planted as a waterside tree in parks and cemeteries. The Weeping Willow strikes easily from cuttings and thrives best on loamy soil near water. It is one of the first trees to come into leaf in the spring.

***Salix matsudana* Koidzumi**

Tree 3–13 m. tall. Twigs greenish-yellow. Leaves lanceolate, tapering at the apex with rounded, rarely acute base, bright green above, glaucous below, about 5–6 cm. long and 1.2–1.5 cm. broad; petiole 2–8 mm. long; stipules lanceolate, short, early deciduous on short shoots. Catkins appear before the leaves, short, cylindric, 1–1.5 cm. long. Pistillate catkins very short, 12 mm. long.

Eastern Asia.

This is the common Peking Willow, very widely planted in North China.



Plate 14. *SALIX BABYLONICA* Linnaeus

1. Staminate branch; 2. Pistillate branch; 3. Mature leaves; 4. Pistillate flower; 5. Staminate flower. (Details enlarged).



Plate 15. *SALIX MATSUDANA* Hayata

1. Pistillate branch; 2. Staminate branch; 3. Sterile branch; 4, 5, 6. Bract & Stamen of staminate flower; 7. Pistillate flower; 8. Bract of pistillate flower.

POPULUS

Deciduous trees with buds covered by several imbricated bud scales. Leaves alternate, pinnately veined, entire, crenate, dentate or serrate, stalked. Flowers dioecious, precocious (appearing before the leaves in the spring), in stalked, pendulous catkins. Staminate flowers in elongated catkins composed of numerous flowers each subtended by a deciduous, toothed, cut or cleft bract. Stamens 4-12 or 20-60 attached by a short filament to the cup-like disk which replaces the perianth; anthers 2 celled, red or purple. Pistillate catkins not so compact; ovary sessile on the oblique, cup-like disk, 1-celled; style short, stigma 2-4. Mature fruiting catkin often moniliform or necklace-like. Fruit a capsule dehiscent into 2-4 recurved valves. Seeds very small, surrounded by tufts of silky hair which gives the mass a cottony appearance.

Quick-growing, intolerant trees, comprising about 50 species, widely distributed throughout Europe, America, Asia and Africa. Poplars thrive on any soil but they prefer alluvial land bordering ponds and streams. They are rapid growing trees, sometimes attaining great size, and are especially suited for windbreaks and hedges. Several species produce timber used in woodworking industries and for paper pulp. The tannin from the bark is used in Europe for curing hides; the leaves are fed to cattle for fodder. Some uses to which poplar wood is put are for flooring, packing cases, wooden shoes, bowls and dishes and matches. Waste land in China might be profitably planted to the poplars. Exotic species recommended for experimentation are:—

P. tremula, *P. tremuloides*, *P. nigra*, *P. deltoidea*, *P. alba*. Propagation by seeds is most uncertain, cuttings afford the practical means of increase. Both the poplars and willows are subject to numerous insect and fungous attacks.

Populus simonii Carriere

A medium sized to tall tree of elegant habit and rapid growth. Young shoots slender, sometimes pendulous, reddish-brown, deeply angled and 5 ridged, conspicuously white lenticled. Leaves small, 5-13 cm. long, diamond shaped or ovate, tapering at both ends, finely toothed, dark green above, pale green below, glabrous on both sides. Petioles short, channeled above, red on young trees. Staminate catkins about 3 cm. long.



Plate 16. *POPULUS SIMONII* Carriere

1. Flowering branch; 2. Sterile branch; 3. Staminate flower enlarged.

North China.

Useful for a quick-growing windbreak. On young sprouts the leaves are broadly elliptical, 7-16 cm. long.

Populus lasiocarpa Oliver.

Tree 18 m. high with dark gray fissured bark and pyramidal or rounded crown. Branchlets pubescent, angled. Leaves very large, sometimes 30 cm. long and 17 cm. wide, deeply cordate at the base, acuminate and gland-tipped at the apex, regularly and glandularly serrate; upper surface with a dense, white, pubescent tuft at the base, glabrescent with age; lower surface more or less tomentose, midribs and veins reddish; petioles red, round. Staminate catkins 10 cm. long. Capsules 2-3 valved, densely tomentose.

North China.

Dr. Henry states that this is a good timber tree.

Populus tomentosa Carriere

Tree 25 m. tall with gray tomentose branchlets and triangular, ovate leaves; margin with 10 or less sinuate teeth on each side.

North and Central China.

Large specimens are growing on the grounds of the Summer Palace in Peking. This is one of the best and largest poplars. The leaves are large.

Populus tremula Linn. **var *Davidiana*** Schneider.

Trembling Aspen.

Medium sized tree up to 20 m. tall at best, producing suckers freely. Young leaves reddish-purple, conspicuous at the time of unfolding. Leaves thin, small, ovate, margin with rounded, incurved teeth; petioles long, slender, laterally flattened. Scales hairy; stigma deeply cleft; stamens 6-8.

This variety is the Chinese representative of the common European Aspen. Several horticultural forms are cultivated, notably a weeping and a tomentose form.

E. Asia and China.



Plate 17. *POPULUS LASIOCARPA* Oliver

1. Staminate branch; 2. Fruits; 3. Leaf; 4. Under side of leaf, showing glands; 5. Bract of pistillate flower; 6. Bract of staminate flower; 7. Staminate flower; 8. Stamen; 9. Hermaphrodite flower; 10. Pistillate flower. (Enlarged details from Hooker's "Icones Plantarum.")

Populus silvestrii Pampanini.

Allied to *P. tremula* of Europe with broadly ovate, acuminate, serrate, long-petioled leaves, tomentose beneath on young trees; on mature trees glabrous.

Central China.

Populus rotundifolia Griff. var. **duclouxiana** Gamboez

Has nearly orbicular, somewhat cordate leaves and very long pistillate catkins (15-25 cm. long). Capsule long pedicelled.

Allied to *P. sieboldii* of Japan.

S. W. China.

Populus suaveolens Fischer

Twigs cylindric, leaves stiff, very thick, finely crenate-serrate, ciliate, ovate to ovate-lanceolate, whitish beneath.

Suitable for hot, dry climate; also for ornamental planting. Rather slow growing but reaches a large size.

Mongolia, Siberia, N. China.

MYRICACEAE

Trees and shrubs. Leaves alternate, simple, serrate, incised or entire. Flowers without perianth, monoecious or dioecious in unisexual or androgynous axillary catkins. In the androgynous inflorescence, the staminate flowers are borne below the pistillate flowers. Staminate flowers with 4 (2-16) stamens in the axil of a bract; ovary rudimentary or absent. Pistillate single or in pairs; ovary 1 celled, 1 ovuled, sessile, in the axil of a bract, with 2-4, rarely 8, bractlets at the base; stigma 2, filiform, sessile, or on a short stalked style. Fruit a drupe, fleshy or succulent or dry or more or less covered with a waxy exudation, or a nut in a scaly involucre. Nutlets hard and bony. Seeds exalbuminous.

Family consisting of 2 or 3 genera and about 50 species.

The following is the only Chinese genus known.

MYRICA

Aromatic shrub or small tree. Leaves deciduous or evergreen, entire, dentate or lobed, mostly resin-dotted, without stipules. Flowers usually

dioecious, without perianth, subtended by minute bractlets. Staminate aments cylindric, opening before or with the leaves, stamens usually 4-6 (2-16). Pistillate aments ovoid or globose, ovary subtended by 2-4, short bracts, 1 celled; stigmas 2, filiform. Fruit a drupe, ovoid or globose, the exocarp dry or fleshy, often waxy; nut thick-walled, 1 seeded.

50 or 60 species in the warm temperate regions of the world. Wax is obtained from the fruits of several species, sometimes used in the making of candles. The astringent bark yields a substance used in tanning, dyeing and for medicinal purposes. The Chinese species is cultivated for its edible fruit.

***Myrica rubra* Siebold and Zuccarini.**

(Yang Mei.) "Strawberry Tree."

Shrub or small tree, with more or less pubescent branchlets. Leaves oblong lanceolate, acute or rounded, cuneate at the base, margin entire or serrate above the middle, dark green above, glaucous and glabrous below, 8-13 cm. long. Stamens 6-10. Fruit globose, deep reddish-purple, succulent, with a sweet, pleasant, acid taste, resembling somewhat a small strawberry in appearance. Stone ovoid compressed, rough.

S. China, Korea and Japan. China: Chekiang, Kiangsi, Kiangsu, Fukien, Kwangtung and Hainan.

Cultivated for its fruit and showing much variation so that there are various named varieties, one having a rose colored fruit of fine flavor. Eaten fresh or preserved, also made into a refreshing drink. Fruits of a dark wine red color, measuring over 2 cm. in diameter are obtainable in the markets of Shanghai in season. The author encountered a specimen measuring 7 m. tall in the Island of Hainan.

JUGLANDACEAE .

Leaves alternate, without stipules, pinnately compound. Flowers monoecious; staminate in catkins, 1 flower to each bract, with or without perianth. Pistillate flowers in clusters of two or three or singly on a pendulous spike, perianth and bracts adherent to the ovary. Ovary inferior, 1 celled, 1 ovuled. Stigma 2-4 parted. Fruit a nut enclosed in a fleshy exocarp, or 4 valved and woody, or winged.



Plate 18. *MYRICA RUBRA* Siebold & Zuccarini

1. Staminate branch ; 2. Fruiting branch ; 3. Pistillate branch ; 4. Section of fruit ; 5. Seed ; 6. Staminate flower ; 7. Pistillate flower. (Details enlarged.)

6 genera in the N. temperate zone. The largest genus is *Hicoria* with 11 species, at one time thought to be purely American, but 1 species has been described from Chekiang.

KEY TO GENERA

A. Branches with chambered pith.

I. Fruit a large drupe with a fleshy indehiscent husk.....*Juglans*.

II. Fruit a winged nutlet.....*Pterocarya*.

B. Branches with solid pith.

I. Fruit a large nut enclosed in a woody dehiscent husk....*Hicoria*.

II. Fruit a nutlet, many together

a. Nutlets winged, borne in a scaly cone.....*Platycarya*.

b. Nutlets not winged, embraced at the base by a 3-lobed bract.....*Englehardtia*.

JUGLANS

Trees with pith in horizontal plates. Leaves deciduous, alternate, compound, aromatic, without stipules. Leaflets opposite, sessile or subsessile, entire or serrate. Flowers monoecious. Staminate flowers in slender, drooping catkins borne on the twigs of the previous year's growth; perianth 2-5 lobed; stamens 6-30, in several series. Pistillate flowers few to many in a terminal erect spike, on the twigs of the current year's growth; calyx 4 lobed; involucre 2-5 parted, adnate to the ovary; ovary inferior, 1 celled, 1 ovuled. Fruit a large drupe with a thick, fleshy, indehiscent husk enclosing a hard-shelled, bony, sculptured nut. Nut 2-4 celled at the base, indehiscent, or splitting into 2 valves. Seeds solitary, lobed, exalbuminous, filling the cavity of the nut. The cotyledons remain in the ground at germination.

About 15 species scattered through N. and S. America, Europe and Asia.

Juglans regia Linnæus.

Walnut.

Trees to 25 m. tall. Leaves large up to 25 cm. long; leaflets 5-13, the terminal one stalked, others subsessile, oblong-ovate or elliptic-oblong, acute or acuminate, entire or sinuate, glabrous, dark green above, pale green beneath, 5-15 cm. long. Pistillate flowers 1-4, usually green with



Plate 19. *JUGLANS REGIA* Linnaeus

1. Flowering branch; 2. Fruiting branch; 3. Twig showing laminate pith; 4. Nut.

purple stigmas. Fruit globose, green, aromatic, the husk splitting irregularly at maturity. Nut roundish or oval, thin shelled and not deeply sculptured, divided in the interior by 2 incomplete septums; the cotyledons 2 lobed, wrinkled and corrugated.

This so-called English or Persian Walnut is indigenous to China, and is commonly cultivated in N. China in various horticulturally named forms or varieties. The wood is purplish-brown in color, practically without characteristic taste or odor; moderately heavy, straight grained and hard, taking a high polish, commanding a high price in the market for high grade furniture-making and for gun stocks.

Juglans cathayensis Dode.

Butternut.

Bush or tree up to 15 m. tall. Branchlets, leaf rachis, and fruit glandular-hairy. Leaflets 9-17, oblong-ovate, acuminate, rounded at the base, serrate, pubescent beneath. Staminate catkins 20-30 cm. long. Fruit 6-10 in a pendulous spike, ovate, pointed, 3-4.5 cm. long. Nuts ovate, pointed, 6-8 angled with prominent, broken ridges.

Central, Western and South Western China. Abundant in Hupeh and Szechuan.

The hard shell and small kernel render this nut of no great commercial value.

Juglans mandshurica, Maximowicz.

Tree 18 m. tall. Branchlets pubescent or glabrescent. Leaflets 11-19, pubescent beneath. Fruits in short racemes, 6-13, globular-ovate to oblong, viscid. Nuts globose or ovate, with a sharp point and 8 prominent ridges.

Manchuria, C. and W. China.

Chihli, Hupeh, Szechuan, Yunnan.

The Chinese butternuts should be taken in hand by hybridizers with the object of improving the quality of the nuts to render them marketable. *Juglans mandshurica* is very hardy.

HICORIA

Trees with solid pith. Leaves deciduous, without stipules, compound, odd pinnate. Leaflets sessile or subsessile, serrate, pinnately veined,

3-17 in number. Flowers monoecious, appearing with the leaves. Staminate catkins pendulous, axillary, clustered, stalked or sessile, many flowered; each flower subtended by a 3-lobed bract; calyx, 3-6 lobed; stamens 3-10. Pistillate flowers on new growth of the season, 2-10, clustered in a spike; calyx 1 lobed; style 2; ovary solitary, 1 celled, 1 ovuled, enclosed in a cup-shaped involucre composed of the union of a bract and 2 bracteoles. Fruit a nut inclosed in a thick husk, more or less dehiscent into 4 valves; nut hard and bony; 2 celled on top, 4 celled at the base. Seeds solitary 2 lobed and more or less wrinkled or corrugated, filling the cavity of the nut, exalbuminous. Cotyledons remain inclosed in the nut at germination.

About 11 species all N. American except 1 recently discovered in China. *Carya* is a synonym for the genus. *Hicoria* is the older name. This is the hickory of commerce.

***Hicoria cathayensis* (Sargent) Chun**

(*Carya cathayensis* Sargent.)

Tree to 29 m. tall. Leaves, 5-7 foliate, 20-30 cm. long. Leaflets subsessile, lanceolate to obovate-lanceolate, acuminate at the base, serrate, 10-14 cm. long, 3.5-5 cm. wide, green above, rusty brown below. Fruit obovoid, 4 ridged at the suture of the husk; exocarp 2.5-3 mm. thick. Nuts ovoid to oval, base rounded, apex with a sharp, short tip, obscurely angled, 2-2.5 cm. long, 1.5-2 cm. in diameter. Cotyledons lobed almost to the apex.

Chekiang and Kweichow.

The nuts are sold in the markets as sweetmeats. They are also expressed for oil used in fancy pastries. The wood is tough and strong, used for tool handles. It is not improbable that other species occur in China.

PTEROCARYA.

Trees with pith in horizontal plates or lamellae. Winter buds scaly or naked, usually stalked. Leaves deciduous, alternate, pinnately compound, without stipules; leaflets subsessile, serrate. Flowers monoecious, numerous in pendulous catkins, appearing with the leaves. Staminate flowers consist of 1-4 sepals and 6-18 stamens in several series, on the axis of 1-connate bracts. Pistillate catkins solitary, terminal, the flower subtended by a bract and 2 bracteoles, the ovary enclosed in a 4-toothed



Plate 20. *HICORIA CATHAYENSIS* Chun

1. Fruiting branch ; 2. Nut ; 3. Section of fruit.

involucre, crowned with a short style divided into 2 papillose lobes at the summit. Ovary 1 celled, 1 ovule in the cell. Fruit, winged nuts attached to a long pendulous axis. Nuts usually 2 winged with thin pericarp and hard endocarp, imperfectly 4 celled at the base, 1 seeded. Cotyledons 4 lobed, carried above ground in germination.

8 species all in Europe and Asia. 6 species occur in China.

***Pterocarya stenoptera* De Candole.**

Trees 18 m. high, with long naked buds. Branchlets villose. Leaves 30 cm. long, rachis winged, or wings reduced or absent, pubescent beneath or nearly glabrous; leaflets 9-25, sessile, coriaceous, oblong or oblong lanceolate, acute, rounded and unequal at the base, serrate, pubescent below on the midribs, 10-12 cm. long. Fruit on pendulous axis sometimes 30 cm. long. Nut with beak-like apex, wings oblong to oblong-lanceolate, usually upright and divergent.

Common in C. and W. China.

A rapid growing tree, planted in Shanghai and other cities as street trees. Wood soft and light, of little known value. It would be advisable to investigate this tree as to its value as matchwood. Its rapid growth renders it capable of being managed on short rotations. It is occasionally badly infested by aphids.

***Pterocarya hupehensis* Skan.**

Tree 8 m. tall. Buds naked. Twigs glabrous. Rachis not winged. Leaflets 5-9 (5 or 7-17 or 19), lanceolate, brown scurfy scaly beneath when young, becoming glabrous excepting for persistent brown stellate hairs along veins and axils of veins beneath. Fruit with suborbicular wing, 12 mm. in diameter.

Hupei.

P. hupehensis does not appear to differ materially from *P. fraxinifolia* Spach, and should probably be regarded as a synonym or mere form of that species.

***Pterocarya paliurus* Batalin.**

Tree 12 m. tall. Twigs glabrescent. Rachis not winged. Leaflets 7. Fruit with the two wings connate, forming a large, orbicular membrane around the nut.

Central China.

The fruit resembles somewhat that of *Paliurus*.



Plate 21. *PTEROCARYA STENOPTERA* De Candole

1. Fruiting branch; 2. Staminate branch; 3. Staminate flower; 4. Pistillate flower; 5. Section of pistillate flower. (Details enlarged).

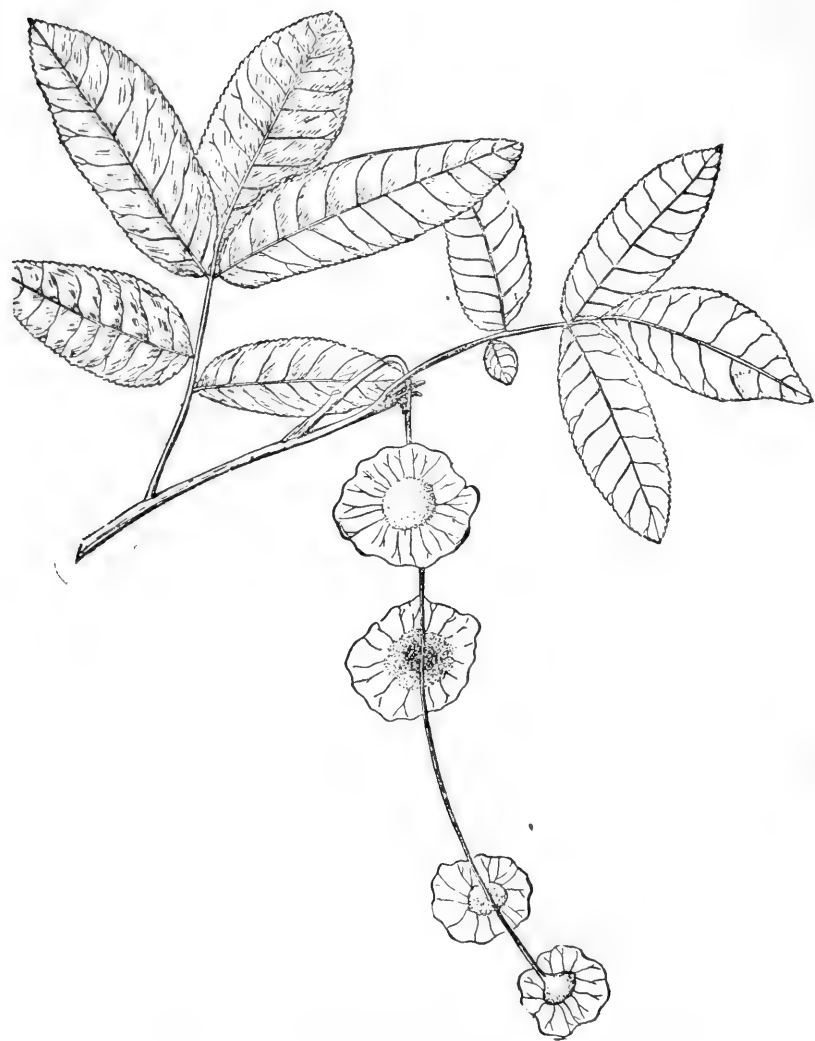


Plate 22. *PTEROCARYA PALIURUS* Batalin

PLATYCARYA

Deciduous trees. Branchlets with solid pith. Winter buds covered by imbricated scales. Leaves odd pinnate; leaflets 5-19, sessile, ovate-lanceolate, long pointed, oblique and wedge-shaped at the base, doubly serrate. Flowers monoecious; staminate catkins axillary, 4-12 together; pistillate solitary, terminal, conelike. Fruit, winged nutlets borne in the axils of the scales of an upright cone.

A monotypic genus distinguished from the other members of *Juglandaceae* by the cone-like fruit bearing small winged nutlets.

***Platycarya strobilacea* Siebold & Zuccarini.**

Bush or small tree, rarely to 20 m. tall with thick, dark gray and deeply furrowed bark. Leaves 15-30 cm. long; leaflets 4-12 cm. long. Cone oval, brown, about 4 cm. long; scales sharp pointed. Nutlets about 4 mm. across.

Kiangsi, Hupeh, Yunnan, Chekiang, Kiangsu.

A black dye for dying cotton cloth is derived from the fruits of this tree.

ENGLEHARDTIA

Trees or shrubs. Branches with solid pith. Leaves pinnate; leaflets entire, serrate. Staminate inflorescence in pendulous spikes; flowers composed of 4-12 stamens on an entire or more or less unequally lobed bract. Pistillate inflorescence a long, pendulous spike; flowers sessile on a 3-4 lobed bract with a 4 parted calyx adnate to the ovary; stigma 2. Fruit a globose nutlet at the base of an unequally 3-lobed bract of which the middle lobe is the longest; nutlet 2-valved.

About 5 species are recognized in India, Malay and China.

***Englehardtia spicata* Blume.**

Small to large half-evergreen tree. Leaves 15-30 cm. long; leaflets more or less membranous, obtuse to acute, unequal at the base, more or less tomentose on the under surface and on the petiolules. Staminate flowers with entire bracts and sessile stamens; pistillate flowers with 3 lobed bracts. Nutlets globose, 6-8 mm. in diameter, villose; bract 5-8 cm. long, the middle lobe linear, oblong and blunt.

India, Java and Southern China.

From the material I have seen, I believe *E. acerifolia* Blume and *E. colebrookiana* Lindley belong here. The latter is characterized by dense tomentum on the under surface of the leaves.

Englehardtia chrysolepis Hance.

(*E. wallichiana* Lindley.)

Leaflets leathery, entire, quite glabrous. Staminate flowers with lobed bracts and usually 12 stamens. Pistillate flower with a 4-lobed stigma. Nutlet globose, 4 mm. in diameter, crowned with a 4-lobed perianth covered with yellow, glandular scales; middle lobe of the bract about 4 cm. long.

Singapore, Hongkong, Yunnan, Szechuan.

BETULACEAE

Trees or shrubs. Branchlets with conspicuous lenticels. Leaves alternate, simple, usually doubly serrate, with stipules. Flowers monocious, in catkins. The staminate 1-3, in the axils of the leaves, with 2-4 parted calyx, or calyx wanting; stamens 2-20, the filaments distinct, inserted on a receptacle; the pistillate with or without calyx; ovary inferior, 2 celled; ovules solitary in each cell, pendulous. Nutlet usually winged, 2 celled, 1 seeded; seeds exalbuminous. Nutlets borne in a strobile (*Betula*, etc.) or as enlarged nutlets enclosed in an involucre (*Corylus*).

Six genera and about 75 species in the Northern Hemisphere. This is an important family, several genera are in cultivation for ornament, fruit or timber. *Betula* is an important inhabitant of the forests of the temperate region, and its timber is a valuable article of commerce.

KEY TO GENERA

- A. Staminate flower solitary in the axils of the scale, without calyx; pistillate flower with calyx; nuts not winged, subtended or enclosed by an involucre formed of the bracts and bractlets of the flower.
- I. Staminate flowers with 2 bractlets; pistillate flower 2-4 capitate; nuts large, enclosed in a leafy involucre . . . *Corylus*.

II. Staminate flower without bractlets; pistillate ament spike-like; nuts small, subtended or enclosed by an involucre.

a. Fruiting bractlet flat, 2 cleft, foliaceous.....*Carpinus*.

b. Fruiting bractlet bladder-like, entire or 3 lobed.

1. Fruiting bractlet entire.....*Ostrya*.

2. Fruiting bractlet 3 lobed.....*Ostryopsis*.

B. Staminate flowers 3-6 in the axils of the scales, with calyx; pistillate flower without calyx, the ament becoming a coriaceous or woody strobile; nuts without involucre, more or less winged.

I. Pistillate ament solitary, the scales deciduous; stamens 2; winter buds scaly; strobile coriaceous.....*Betula*.

II. Pistillate ament racemose, the scales becoming thick, woody and persistent; stamens 4; winter buds without scales...*Alnus*.

OSTRYA

Small trees. Buds scaly, pointed. The staminate flower buds in terminal, naked catkins; the pistillate flower buds enclosed in axillary scaly buds. Leaves deciduous, doubly serrate, stalked, pinnately veined, stipules oblong or lanceolate, deciduous. Flowers monoecious, apetalous; the staminate clustered, in pendulous, terminal catkins; pistillate catkins from axillary buds, erect, each scale bearing 2 ovaries, calyx adnate to the ovary; ovary inferior, 2 celled, 1 ovuled; each pistil enclosed in a hairy sac-like involucre formed by the union of the bracts and the bracteoles. Fruit a stalked strobile composed of the imbricated, inflated, bladder-like involucre enclosing a nutlet. Nutlet ovoid, compressed, sessile, crowned by the remnant of the calyx, conspicuously ribbed. Seeds solitary.

4 species in N. America, Europe, and Asia.

The species are so closely allied that botanists are disposed to regard them as geographical variants of the same species. The genus is easily recognized by the cone or hop-like fruits composed of flattish, inflated, membranous, bladder-like bracts each enclosing a small, bony nutlet. The tree is slow growing and never attains a large size, and the hard, close-grained wood has little commercial value, although locally useful. The seeds usually do not germinate until the second year.

***Ostrya japonica* Sargent.**

A small tree sometimes 16 m. tall. Young branchlets pubescent. Leaves densely pubescent beneath, round or slightly cordate at the base, 5-10 cm. long. Fruit about 4 cm. long, peduncles somewhat shorter.

N. E. Asia. China: Szechuan and Hupeh.

OSTRYOPSIS

A monotypic genus, closely related to *Ostrya*, resembling it in habit and foliage, but differing in the fruit, which is inclosed in a 3-parted involucre, several imbricated together to form a catkin-like head.

***Ostryopsis davidiana* Decasne** is a low shrub.

Mongolia; N. and W. China.

CARPINUS

Trees. Buds rounded or acute with numerous imbricated scales. Leaves deciduous, alternate, stalked, doubly serrate, pinnately veined, the veins ending in the tips of the teeth; stipules deciduous. Flowers monocious, apetalous, in solitary, lateral catkins; the staminate naked or more or less concealed within scaly buds in the winter. Stamens 3-20, 2 forked at the apex, crowded on a pilose torus or receptacle, adnate to the base of each scale. Pistillate flowers (from lateral, scaly winter buds) in catkins or spikes, terminating leafy lateral shoots, the flowers in pairs at the base of each scale, each subtended by a bract and 2 bracteoles which develop into a large leafy, more or less 3 lobed bract. Calyx adnate to the ovary; ovary inferior, 2 celled, 1 ovule in each cell. Nutlet ovate, acute, ribbed, crowned by the remnant of the calyx lobes, embraced at the base by the bract-like involucre.

About 20 species in Asia, Europe, N. and C. America. *Carpinus* is distinguished by the fruit composed of a nutlet surrounded at the base by an involucre of 3-lobed, or serrated bracts. The genus is useful chiefly in ornamental planting. The wood of some species is hard and close grained and is used in the making of tool handles and other small services.

***Carpinus cordata* Blume.**

Tree up to 15 m. high. Bark gray, scaly and deeply furrowed. Branchlets orange to light brown, conspicuously lenticelled, pubescent at



Plate 23. *OSTRYA JAPONICA* Sargent

1. Fruiting branch; 2. Section of fruit; 3. Staminate branch; 4. Stamen, enlarged; 5. Pistillate flower, enlarged.

first. Buds conspicuous, large, sometimes 2.5 cm. long, acute, covered with chestnut-brown scales. Leaves ovate or ovate-oblong, acuminate, deeply cordate and oblique at the base, 8-15 cm. long, unequally serrate, dark green above, pale green and pubescent below, veins 15-20 pairs, impressed above. Fruit 8-15 cm. long, with broadly ovate, remotely serrate bracts, lobed at the inner margin, the lobes often large ($\frac{1}{3}$ the length of the bract), embracing the basal portion of the nutlet.

N. E. Asia. China, Korea, Manchuria and Japan.

CORYLUS

Shrubs or trees. Leaves deciduous, alternate, petioled, serrate, pinnately veined, stipulate. Flowers monoecious, apetalous, precocious, (flowering before the leaves). Staminate in cylindrical, pendulous, terminal or lateral catkins, solitary or several together, the catkins composed of numerous closely imbricated scales, each bearing 4 bifid stamens and 2 adnate bracteoles. Pistillate flowers from lateral scaly buds which develop into short leafy branchlets, the flowers and fruit being terminal. Pistillate flowers with 2 red, protruding styles; ovary 2 celled, subtended at the base by 2 laciniate bracteoles. Fruit single or in clusters, a 1-seeded nut surrounded by a leafy involucre variously lobed or cut. Seeds exalbuminous.

About 20 species, 5 or 6 of which are ascribed to China. *Corylus* yields the hazelnut of commerce and several species are cultivated in Europe and America for their fruits. The nut is rounded or oval, enclosed in a leafy involucre which is tubular, variously cut and lobed and open at the summit. The seeds should be sown in the autumn or stratified until spring.

The only arborescent Chinese species is:—

***Corylus chinensis* Franchet.**

Tree 35 m. tall with rounded top. Branches horizontal and spreading. Young shoots tomentose. Leaves large, 12 cm. long, broadly ovate to ovate-oblong, doubly serrate, acuminate, slightly cordate and very oblique at the base, glabrous above and pubescent below and setulose along the veins; petiole tomentose, 6-25 mm. long. Fruit 4-6 in a cluster, variable in size; involucre striate, constricted above the nut, more or less furcate, recurved, finely pubescent.

W. China: Yunnan, Szechuan and Hupeh.

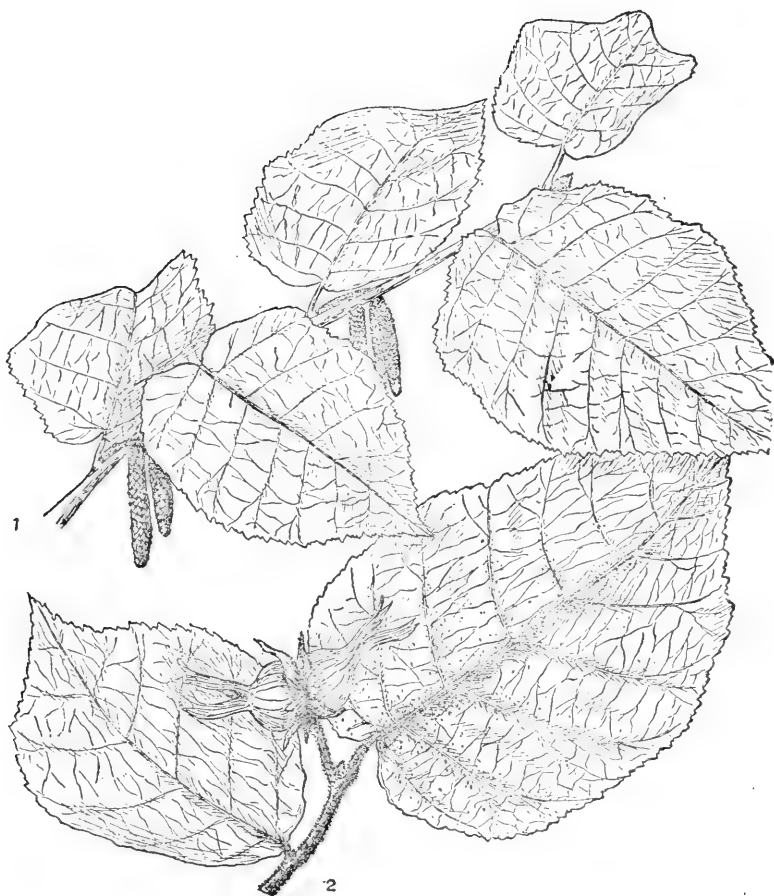


Plate 24. *CORYLUS CHINENSIS* Franchet

1. Staminate branch; 2. Fruiting branch.

This tree grows in mixed forests and sometimes attains a height of 100 feet. It is closely allied to the European tree hazel *Corylus colurna*, of which it was once considered a variety.

ALNUS

Trees or shrubs. Leaves deciduous, alternate, stalked, serrate or dentate, rarely entire, pinnately veined, stipules deciduous. Leaf buds in winter usually stalked, club shaped, few scaled. Flowers monoecious in cylindrical catkins, apetalous. Staminate catkins terminal or subterminal, elongated, in clusters of 2-6, conspicuous in winter; flowers small, 3 to each scale; stamens 4, filaments short, undivided; calyx 4 lobed. Pistillate catkins much smaller than and below the staminate, naked in winter or concealed within lateral scaly buds, several together or rarely solitary; flowers naked, 2 to each bract; ovary 2 celled, ovules solitary in each cell; style 2. Fruit a strobile or woody cone with persistent scales, remaining on the branches after the liberation of the nutlets. Nutlets winged or wingless, 1-seeded by abortion.

About 25 species in Europe, Asia and N. America. The genus is characterized by staminate catkins appearing before the leaves and by pistillate flowers developing into woody cones. Nearly all the species prefer moist situations and they are usually found alongside of ponds and streams. The wood of some species is hard and durable in water.

***Alnus cremastogyne* Burkill.**

Tree 30 m. tall with rough, gray bark. Young branchlets glabrous. Leaves obovate or ovate, acuminate, rounded or broadly cuneate at the base, margin irregularly serrate, smooth, dark green above, paler and with tufts of brown hairs on the veins below, 6-13 cm. long; petioles 6-13 mm. long. Catkins solitary, axillary, appearing in the spring. Cone ovate, solitary, 2 cm. long; peduncles 4-5 cm. long. Nutlet provided with a broad wing.

Szechuan.

This tree is suitable for planting in wet sites. The wood is used chiefly for fuel and it is occasionally planted along the borders of rice fields, apparently for this purpose.

Alnus lanata Duthie may be a form of the above.

The other Chinese species are shrubby.



Plate 25. *ALNUS CREMASTOGYNE* Burkill

1. Fruiting branch; 2. Staminate branch.

BETULA

Trees or shrubs. Bark with conspicuous lenticels, often peeling in thin, papery strips, frequently white. Lateral buds usually sessile, scaly and pointed. Leaves deciduous, alternate, stalked, pinnately veined, serrate or crenate or incised; stipules caducous. Flowers monoecious, apetalous. Staminate catkins cylindric, naked, solitary or several together, terminal or lateral, conspicuous in winter, flowering in spring before or with the leaves. Flowers 3 to each scale; stamens 2, divided at the apex; calyx 1-4 parted. Pistillate catkins from lateral scaly buds developing with the leaves, the flowers of these catkins in 3's, without calyx; ovary 2 celled, 1 ovuled; style 2, stigmatic at the tip. Fruit cylindric or cone-like; scales 3 lobed, deciduous, falling with the winged nutlets. Nutlets compressed with a more or less developed and often transparent wing on each side and crowned by the remnant of the style at the apex.

About 35 species of birches are known, a considerable number are shrubs. Probably 10 or 12 species occur in China. The birches are widely distributed and occupy a great range of situations. Several arborescent species are important forest trees producing a close-grained, moderately hard wood which is esteemed for cabinet and furniture making, interior finish and for small woodenware such as shoe lasts and spools. It has a high fuel value. The bark is impervious to water and that of several species is sometimes stripped from the tree in long sheets by the American Indians and fashioned into light boats which they call canoes. Boxes, shoes and boots are also made from the bark. The leaves and bark yield a medicine. The sweet sap tapped from several species is made into a pleasant beverage.

The Chinese species of birches can be certainly known only after extensive collections from various parts of the country have been made and a comparative study undertaken. Species have been described by European and American botanists based on fragmentary material out of forms which are undoubtedly only geographical variants.

***Betula japonica* Siebold.**

(*B. alba* Turczaninow.)

(*B. alba* var *japonica* Rehd.)

Small tree, 25 m. tall with glabrous, glandular or glandless branches. Leaves broadly cuneate, truncate or rounded at the base, deltoid-ovate,



Plate 26. *BETULA JAPONICA* Siebold

1. Fruiting branch and an enlarged pistillate flower; 2. Flowering branch; 3, 4. Front and back of seed; 5, 6, Staminate flower; 7. Stamen. (Details enlarged.)

acuminate, simply or doubly serrate, glabrous or pubescent below with tufted hairs on the axils of the veins, 5-7 cm. long, 3.5-6 cm. wide; petioles 1.5-2 cm. long. Strobile solitary, about 2.5 cm. long. Nutlet oblong or ovate-oblong with thin, transparent wings.

N. E. Asia. China: Chihli.

Several varieties of this tree have been distinguished, but for all practical purposes they may be disregarded by foresters.

Propagated by seeds. The number of seeds per lb. is about 777,600.

Betula davurica Pallas.

Tree 20 m. tall. Bark purplish-brown. Branchlets hairy, glandular. Leaves about 8 cm. long, narrow ovate to ovate-rhombic, acute, cuneate at the base, irregularly serrate, pubescent along the veins beneath. Strobile ovoid-cylindric with glabrous scales; nutlets very narrow winged.

Amurland, Manchuria, Korea, Japan, and N. China.

This tree is distinguished by the shaggy, purplish-brown bark.

Betula albo-sinensis Burkill.

(*B. utilis* var *sinensis* Winkler.)

Tree 30 m. tall with orange-red bark and glabrous, shiny branchlets. Leaves ovate, acuminate, doubly serrate, rounded at the base, somewhat glabrous beneath, with 9-10 pairs of veins, 4-8 cm. long. Cones cylindric, about 4 cm. long.

Central and W. China.

Betula alnoides Hamilton.

Tree 20 m. tall with brown bark. Branchlets pubescent. Leaves glossy green, glabrous or nearly so, ovate-oblong to lanceolate, 6-16 cm. long, doubly serrate, with 10-13 pairs of veins

Allied to *B. maximowiczii*.

India to Yunnan.

Betula luminifera Winkler.

Tree 20 m. tall with smooth yellow-gray to reddish-brown bark. Leaves ovate, subcordate, serrate with acute teeth, 8-13 cm. long. Strobile solitary, 5-8 cm. long.

Allied to *B. alnoides*.

Central China. This tree is common at low elevations within its range.

FAGACEAE

Leaves alternate, with stipules. Flowers monoecious, rarely dioecious. Stamens 2-4 or indefinite. Ovary inferior, 2-6 celled; ovules solitary or in pairs. Fruit a nut, more or less inclosed in bract-like scales, usually to form a spiny, scaly or woody cup or involucre. Nut generally 1 seeded by abortion of some of the ovules.

The family has 6 genera and about 600 species widely distributed. *Nothofagus* is confined to the S. Hemisphere. All the genera are represented by important timber trees.

KEY TO THE CHINESE GENERA

- A. Staminate flowers capitate; the pistillate in 2-4 flowered clusters; nuts triangular *Fagus*.
- B. Staminate flowers in slender aments; nuts more or less rounded.
 - I. The pistillate flowers in 2-5 flowered clusters, below the staminate in a bisexual ament.
 - a. Fruits inclosed in a prickly bur.
 - 1. Fruit maturing in 1 season; leaves deciduous; ovary 6 celled; branchlets lengthening by means of an axillary bud; bud scales 4 *Castanea*.
 - 2. Fruit maturing in 2 seasons; leaves persistent; ovary 3 celled; branchlets lengthening by means of a terminal bud; bud scales numerous.... *Castanopsis*.
 - b. Fruit inclosed partly in a more or less scaly cup, usually spicate..... *Lithocarpus*.
 - II. Pistillate flowers solitary in a few-flowered unisexual spike; fruit more or less inclosed in a scaly cup..... *Quercus*.

FAGUS

Trees or shrubs. Buds scaly, elongated and pointed. Leaves deciduous, alternate, pinnately veined, serrate. Stipules linear, lanceolate, early

deciduous or rarely persistent. Staminate flowers in many flowered, globose fascicles on drooping peduncles; calyx 4-7 lobed; stamens 8-10, attached to the base of the calyx by slender filaments. Pistillate flowers in clusters of 2-4, nearly sessile or rarely long stalked, surrounded by numerous bractlets, the outer ones deciduous, the shorter inner ones united to form a 4-lobed involucre; calyx 4-5 lobed, 3 angled; ovary inferior, 3 celled, 2 ovules in each cell; styles 3. Fruit 2-4 nuts inclosed in a woody, prickly involucre which splits into 4 valves. Nuts ovate, 3 angled, chestnut brown, marked by a triangular scar at the base, crowned with the remnants of the style.

E. N. America, Europe, N. and C. China, and Japan.

About 16 species are known. The beeches are characterized by smooth gray bark and elongated, scaly pointed buds. The widely distributed European species, *Fagus sylvatica*, is an important timber tree, remarkable for its tolerance of heavy shade, and on this account, it is planted under oaks and pines to be harvested in 60-80 years before the slower growing species come into maturity. In China the beeches form pure forests of no great extent. The wood is hard and close grained, strong but not durable, suitable for the manufacture of woodenware and agricultural implements and when thoroughly impregnated with creosote, makes fairly durable railroad ties. The nuts are sweet and edible, occasionally ground into flour and in Europe, particularly in France, largely expressed for a sweet oil used to adulterate olive oil, also for soap making and for illumination. The beeches sprout freely from the stump and are therefore suitable for coppice management. Drying destroys the vitality of the seeds; they should be sown in a fresh condition.

Fagus sinensis Oliver.

(*Fagus sylvatica* var *longipes* Oliver.)

(*Fagus longipetiolata* Seeman.)

Tree up to 16 m. tall. Leaves to 8 cm. long, oval, pointed, broadly cuneate at the base with 10-11 pairs of veins ending in the teeth which are sharply serrate; petiole up to 1 cm. long. Fruit about 2 cm. long on stalk about 5 cm. long or less.

Hupeh, Szechuan and Yunnan.

Dr. Henry reported a tree 15 m. in girth. *Fagus sinensis* usually occurs in mixed woods in company with oaks and maples and other

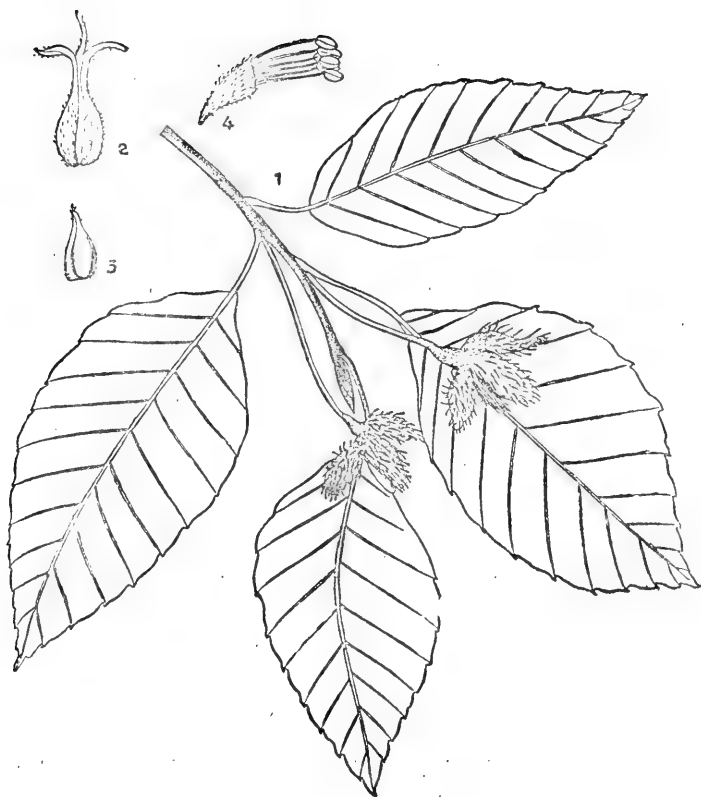


Plate 27. *FAGUS SINENSIS* Oliver

1. Fructing branch; 2. Pistillate flower; 3. Seed; 4. Staminate flower.
(Details enlarged.)

deciduous species. Occasionally it forms pure stands. The wood of this tree is used for boat building and the making of plows and tool handles. When thoroughly impregnated with creosote it makes good railroad ties, mine-props and foundation timber. From the seeds, an oil suitable for cooking and lighting, is sometimes extracted.

***Fagus engleriana* Seeman.**

Tree 15 m. high with brownish twigs. Leaves up to 5.8 cm. long, 4.2 cm. wide, papery, oblong-ovate or obovate, short pointed, rounded or obtuse at the base, bright green above, gray-green, glabrous or glaucescent below, shallowly crenate or slightly toothed, with 12-13 pairs of lateral nerves which curve near the margin; petiole 1 cm. long. Fruit ovoid with gray-brown hairy scales, opening into 4 valves, about 1.5 cm. long on a glabrous stalk 7.5 cm. long. Nuts enclosed, oval or 3 angled, pointed, hairy.

Hupei and Szechuan.

This beech is reported to form pure stands with no individuals attaining any great size. Dr. Augustine Henry discovered it in western Hupei growing on wooded cliffs.

A third species *Fagus lucida*, based on incomplete material, has been proposed by Rehder and Wilson. The leaves of this species are green on both sides with more or less sinuate margins and irregular teeth sometimes ending in mucronate tips. Until the flowers and fruits are discovered this species may be disregarded for practical purposes.

CASTANEA

Deciduous trees or shrubs. Buds with few overlapping scales. Leaves alternate, serrate, oblong to lanceolate, pinnately veined, the veins ending in the sharp bristle-tipped teeth. Flowers monoecious, apetalous, strongly scented, in slender, elongated, upright aments. The lower aments bear only staminate flowers, the pistillate flowers being borne only at the base of the uppermost aments of the branch. Staminate flowers 2-3, crowded in a bract; calyx 6 parted; stamens 10-20. Pistillate sessile, solitary or 2-3 together, inclosed in a scaly involucre with a bract and 2 bracteoles at the base; styles 6; ovary inferior, 6 celled, 2 ovules in each cell. Fruit usually 1-3, or occasionally more nuts in an involucre or bur armed with branched spines. The bur splits open at maturity into 2-4 valves.



Plate 28. *FAGUS ENGLERIANA* Seeman

1. Flowering branch; 2. Fruiting branch.

Nuts rounded or compressed, dark-brown, shiny, tomentose or pubescent at the apex to which the remnant of the style remains attached, marked by an oval scar at the base. Seeds solitary or occasionally 2-3 in each nut, the abortive ovules are attached to the apex of the seed.

About 10 species known in Europe, North America, N. Africa and Asia. About 3 species have been ascribed to China. The chestnut is cultivated in Europe, America and Asia as a fruit tree. The nuts ground into flour and made into a porridge constitute an important food of the peasants of France, Italy and Spain. In China many varieties are under cultivation, separable into 2 distinct types, one characterized by a large nut, similar to the Spanish chestnut, and the other by a small nut esteemed for its very fine flavor. The wood is pale, with dark brown heart wood, coarse grained, porous, very durable in contact with the soil and for construction purposes, inferior only to the oak. Chestnut timber for railway ties, telegraph and telephone poles, finds a ready market in America. The chestnuts are grown under coppice management to supply posts and poles and staves for barrel making. Unfortunately the chestnuts are liable to several serious fungous infestations, the most destructive one, known as the Chestnut Bark disease, has rendered the growing of the chestnut in America impracticable.

Castanea differs chiefly from *Castanopsis* by being deciduous while *Castanopsis* is evergreen.

***Castanea mollissima* Blume.**

(Pan Li.) Chestnut.

Tree 15-20 m. tall with deeply fissured bark and pilose young branches. Winter buds short, broadly ovate and tomentose. Leaves ovate-oblong to oblong-lanceolate, pointed, rounded or truncate at the base, coarsely and irregularly serrate, smooth above, more or less densely tomentose with stellate hairs below, 9-15 cm. long on a short pubescent stalk. Staminate aments as long as the leaves. Fruit variable in size, light brown with pubescent spines. Nuts up to 2.5 cm. across.

Indigenous to the mountains of western China.

Widely cultivated. This chestnut attains a large size when permitted to grow, but around habitations the biggest trees have been cut off and it is now most commonly met with as a small tree or bushy shrub. The nuts are sold in the markets, and are noted for their size.



Plate 29. *CASTANEA MOLLISSIMA* Blume

1. Flowering branch; 2. Fruiting branch; 3. Seed; 4. Nut; 5. Bur, exposing nuts.

***Castanea henryi* (Skan) Rehder and Wilson.**

(Castanopsis henryi Skan.)

(Castanea vilmoriana Dode.)

Tree 20-25 m. tall, occasionally taller. Leaves 10-19 cm. long, green on both sides, glabrous, pubescent only on the midrib and veins below, long acuminate, widest at or below the middle, with bristle pointed teeth. Fruits solitary or 2 or more on a short spike; nuts globose, 12 mm. across, usually 1 in the involucre.

Central China.

A very valuable tree, yielding the largest merchantable timber of any Chinese species. The nuts are small.

Castanea seguinii Dode is a third species native in Chekiang, Hupeh, Kiangsi and other parts of China. It may be separated from the other species by the leaves, which are densely minutely lepidote on the under side, the others being glabrous on the lower surface.

Castanea crenata Siebold and Zuccarini is a fourth species found in eastern Asia but, so far as known, is confined to Japan and Korea.

CASTANOPSIS

Evergreen trees or rarely shrubs with alternate, entire or dentate, pinnately veined leaves. Flowers monoecious, in erect spikes. Staminate flowers usually in 3's on simple or branched spikes; calyx 5-6 lobed or parted; stamens usually 10-12 or indefinite. Pistillate flowers solitary or rarely in pairs, enclosed in an involucre of imbricated scales in simple or branched spikes or scattered at the base of the male inflorescence; calyx 6 lobed; ovary inferior, 3 celled; ovules 2 in each cell; styles 3. Fruit matures at the end of the second year, globose, armed with spines, enclosing 1-4 nuts.

About 35 species described, 15 of which have been ascribed to China. The chief distinction between *Castanea* and *Castanopsis* is that *Castanea* is deciduous while *Castanopsis* is evergreen. In *Castanopsis* the ovary is 3 celled and the fruit matures in the second year.

***Castanopsis hystrix* De Candole.**

Trees with pubescent young shoots and inflorescence. Leaves 6-15 cm. long, coriaceous, lanceolate or oblong-lanceolate, acuminate, entire

or rarely remotely serrate near the apex, obtuse or slightly tapering to the base, glabrous above, tomentose below, glabrescent with age. Pistillate flowers in 3's, covered by numerous small, pubescent bracteoles. Fruit 5 cm. in diameter, slightly 4 angled, armed with straight, stiff spines. Nuts 3 or rarely 1, ovoid-conic, more or less 3-angled.

Himalaya to China: Szechuan, Yunnan, Fukien.

This species occupies the place in the subtropical regions that the more important oaks do in the temperate zone.

***Castanopsis schlerophylla* Schottky.**

Tree to 20 m. with smooth, dark-gray bark. Leaves oval to oblong-ovate to oblong, acuminate, serrate above the middle, glabrous, glaucescent beneath, 6-15 cm. long. Fruits in dense spikes with peduncles to 10 cm. long; involucre dehiscent, ovoid with close, concentric ridges of small tubercles not wholly enclosing the solitary conical nut.

E. & Central China.

The nuts of this species are made into a paste which constitutes a common food for the peasants.

***Castanopsis fargesii* Franchet.**

Tree to 35 m. Branchlets glabrous. Leaves elliptic-oblong to lanceolate, acuminate, serrate above the middle, yellowish or grayish tomentulose beneath, almost glabrous at maturity, 5-13 cm. long. Staminate aments solitary, flowers white, stamens about 6 mm. long. Fruit about 2 cm. across in stout spikes to 15 cm. long with stout, often reflexed fasciated spines, about 8 mm. long. Nut usually solitary, wholly inclosed.

Central and West China.

This species is common in Western China, occurring with other species and often attaining a large size. It is a handsome evergreen tree especially attractive at the time of flowering.

LITHOCARPUS

Trees. Leaves persistent, entire or dentate, alternate, petiolate, stipules of upper leaves persistent. Flowers monoecious, in erect

unisexual or bisexual aments. Staminate flowers in 3's, subtended by 1 basal and 2 lateral bracts; calyx 5 lobed, tomentose; stamens 10; ovary abortive. Pistillate flowers scattered at the base of the staminate aments of the uppermost branches, solitary, subtended by 1 acute bract and minute bractlets; calyx 6 lobed; stamens 6, anthers abortive; ovary 3-celled, ovules 2 in each cell; styles 3. Fruit an ovate nut surrounded at the base by the woody, cup-like involucre more or less covered with imbricated scales. Fruit matures in the second year. The nut is 1-seeded by abortion.

Lithocarpus is intermediate between the chestnut and the oak. The inflorescence is chestnut-like; the fruit resembles an acorn. The genus is mostly subtropical.

About 100 species in S. E. Asia and 1 in W. America. Under this genus are included 3 other genera, namely: *Passania*, *Cyclobalanus* and *Synaedrys*.

***Lithocarpus spicata* (Smith) Rehder & Wilson.**

(*Quercus spicata* Smith.)

Evergreen tree to 13 m. tall. Leaves coriaceous, entire, glabrous, shiny, thick, elliptic-lanceolate or obovate-oblong, subacute to acuminate at the apex; petiole 2.5 cm. or less long. Staminate spikes tomentose, 5-20 cm. long in terminal panicles or solitary and axillary; perianth 5-6 cleft; stamens 10-12. Fruit crowded or clustered on stout erect spike. Cupules 1.2-2.5 cm. across, enclosing the nut when young, shallow and embracing at most the lower third of the acorn at maturity. Nut ovoid-conic to subglobose, hard, smooth and shiny.

Yunnan and Szechuan, India & Java.

The wood is hard and tough. As generally accepted by botanists this is a very variable species extending over a great area. Some of the variations have been given names and it is possible that our Chinese trees which have been called *L. spicata* var. *mupinensis* by Rehder & Wilson may prove to be a distinct species, in which case it should be known as *L. mupinensis* Chun. The leaves appear to be smaller and with longer petiole than the *L. spicata* seen as collected in India.

Lithocarpus spicata var. *yunnanensis* appears to be hardly separable from *L. cleistocarpi* (Seeman) Rehder & Wilson found in Hupeh and Szechuan.

L. Henryi (Seeman) Rehder & Wilson is found in Hupeh and Szechuan.



Plate 30. *LITHOCARPUS SPICATA* Rehder & Wilson

1. Flowering branch; 2. Fruiting spike; 3. Staminate flower, enlarged;
4. Nut.

L. megalophylla Rehder & Wilson from Szechuan appears to be rare. *L. viridis* (Schottky) Rehder & Wilson is another species common in Western China.

QUERCUS

Trees or shrubs. Buds usually clustered at the ends of the twigs, scales numerous, imbricated in 5 ranks. Leaves alternate, stalked, entire, toothed or lobed, deciduous or persistent. Flowers monoecious, or dioecious, apetalous. Staminate flowers in slender catkins from axils of leaves or scars of the previous year, numerous, with 4-7 lobed calyx; stamens with slender filaments, 4-6, rarely more. Pistillate flowers few and inconspicuous, solitary or in a few flowered spike, enclosed in an involucre of imbricated scales; calyx 6 lobed; ovary 3-5 celled; ovules 2; style 3-5. Fruit a rounded nut (acorn) marked with a pale scar at the base, more or less surrounded by a scaly woody cup, 1 seeded.

About 250 species, widely distributed in the whole world, a large number occurring in China. The genus consists of evergreen or deciduous trees with alternate, entire, dentate, lobed or cleft leaves and oval or rounded nuts more or less surrounded at the base by a scaly, woody cup. The nuts or acorns require 1 or 2 years to mature. The oaks, for the most part, are hardy, long lived trees producing valuable timber. The wood of most species is tough, strong and durable, valued for many uses, notably for shipbuilding, house construction, cartwrighting, furniture and interior finish. The bark of several species is used for tanning, that of a Mediterranean species (*Q. suber*) yields the cork of commerce. The nuts of several species are edible. In China silkworms are fed on the leaves of several oaks. Several fungi growing on the oaks are edible. Some of them are cultivated on saplings felled for the purpose. The oaks are propagated by seeds. Transplanting is difficult on account of the long tap root.

The seeds should be sown as soon as ripe, preferably in the autumn, in the place where they are expected to grow. Where spring sowing is practiced, the acorns should be stratified in moist sand over winter. Germination sets in about 5 weeks after sowing in the spring. The tap root of the seedling must be partly removed before transplantation. One year old transplants are suitable for setting out in the permanent forest.

The evergreen oaks are especially difficult to transplant successfully.

***Quercus variabilis* Blume.**

(*Q. chinensis* Bunge.)

Tree to 25 m. tall, usually medium sized, with pale gray, furrowed, thick, corky bark. Branchlets pubescent, glabrescent or glabrous. Leaves ovate-oblong to oblong-lanceolate, acuminate, coarsely serrate with bristle teeth, dark green and glabrous above, densely gray, tomentose beneath, 9-15 cm. long; petiole slender. Fruit matures in second year, subsessile, solitary or occasionally in pairs; acorn subglobose; cup nearly enclosing the nut; scales thick, lanceolate, recurved.

Yunnan, Hupeh, Szechuan, Shantung to Japan. Closely allied to *Q. serrata* from which it differs by the leaves, which are tomentose on the under surface, and by the smaller acorn, in a cup with thicker, shorter scales. The wood is used for general construction and the bark occasionally for floating fish nets. The cupules yield a black dye. Edible fungi are sometimes produced on the decaying wood of this species.

The chestnut-like foliage is characteristic.

***Quercus mongolica* Fischer.**

(*Quercus crispula* Blume.)

(*Q. grosseserrata* Blume.)

Deciduous tree to 35 m. tall. Branchlets and buds glabrous. Leaves membranous, obovate to obovate-oblong, acuminate, cuneate or auriculate at the base, coarsely toothed, with short, broad, obtuse teeth not mucronately tipped, dark green and glabrous above, pale green and glabrous or only slightly hairy along the veins beneath, 10 to 20 cm. long; petiole less than 6 mm. long. Fruit ripening in one year, clustered or solitary, on a short stalk or subsessile; acorn ovoid, about 2 cm. long; cupule embracing about 1/3 the nut, scales ovate, appressed, thickened, tuberculate, slightly fringed at the margin.

E. Siberia, N. China to Korea and Japan.

Widely distributed. The timber of vigorous trees is valuable.

Attempts have been made to differentiate one or more varieties of this species, particularly as *Q. mongolica* var. *grosseserrata* by Rehder & Wilson, but these authors admit, and abundant specimens show no constantly reliable characters for surely separating the forms or variations.



Plate 31. *QUERCUS VIRIABILIS* Blume

1. Fruiting branch; 2. Fruit; 3. Staminate flower, enlarged; 4. Acorn.

Quercus liaotungensis Koidzumi, with smaller leaves and fruit may be a form of *Q. mongolica*.

***Quercus serrata* Thunberg.**

Deciduous tree to 25 m. tall, with dark gray, rough, fissured bark. Young branchlets and leaves silky pubescent, becoming glabrous. Leaves oblong-lanceolate, acute, or acuminate, rounded or cuneate at base, serrate with bristle tipped teeth, green and glabrous on both surfaces or with scattered hairs in the axils of the veins beneath, 10 to 20 cm. long, 2.5 to 5 cm. wide; petiole 2.5-4 cm. long. Fruit ripening the second year, nearly sessile or in pairs. Acorn shiny, glabrous, globose to cylindric, 2-2.5 cm. long. Cup hemispherical, woody, with free, more or less tomentose scales, embracing the lower $\frac{3}{4}$ of the nut.

India to China and Japan. (Hupeh, Szechuan, Chekiang, Chihli, Shantung, Kweichow.) This is one of the silkworm trees. The cupules yield a black dye. The wood is used for general construction and ship-building. The tree is not exacting in its soil requirements.

***Quercus glandulifera* Blume.**

Tree up to 25 m. tall, more often shrubby under cultivation. Branchlets slender with appressed, silky hairs when young. Buds ovoid, with glabrous, ciliate scales. Leaves oblong-obovate or oblong-lanceolate, acute, usually cuneate or rounded at the base, 10-18 cm. long, 3-10 cm. wide, with 7 to 12 pairs of glandular-tipped, acute teeth. Upper surface dark green and lustrous, gray-green, silky, pubescent below. Fruit stalked, usually clustered. Acorn ovate to oblong-cylindric, about 12 mm. long. Cup shallow, with lanceolate, appressed scales, enclosing about $\frac{1}{3}$ the nut which matures in the second year.

Widely distributed throughout China, Korea and Japan. (Kiangsi, Hupeh, Kiangsu, Szechuan and Shantung). In autumn the foliage turns orange and crimson.

***Quercus fabri* Hance.**

Small evergreen tree to 15 m. tall. Branchlets furrowed, with scattered red hairs. Leaves coriaceous, obovate to oblong, sinuately and shallow-lobed, slightly hairy above, dense tomentose and usually reticulate below, to 18 cm. long; petiole short. Fruit ripening in 1 year,



Plate 32. *QUERCUS SERRATA* Thunberg

1. Sterile branch; 2. Fruiting branch; 3. Stamen; 4. Acorn; 5. Fruit. (3 enlarged.)

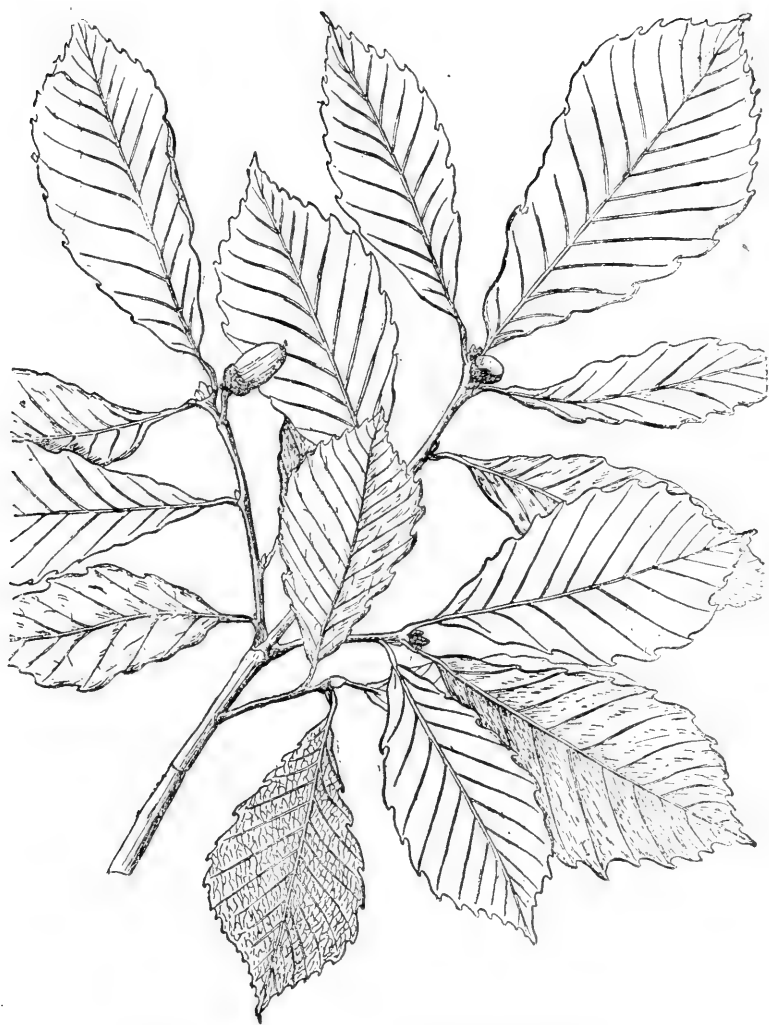


Plate 33. QUERCUS GLANDULIFERA Blume

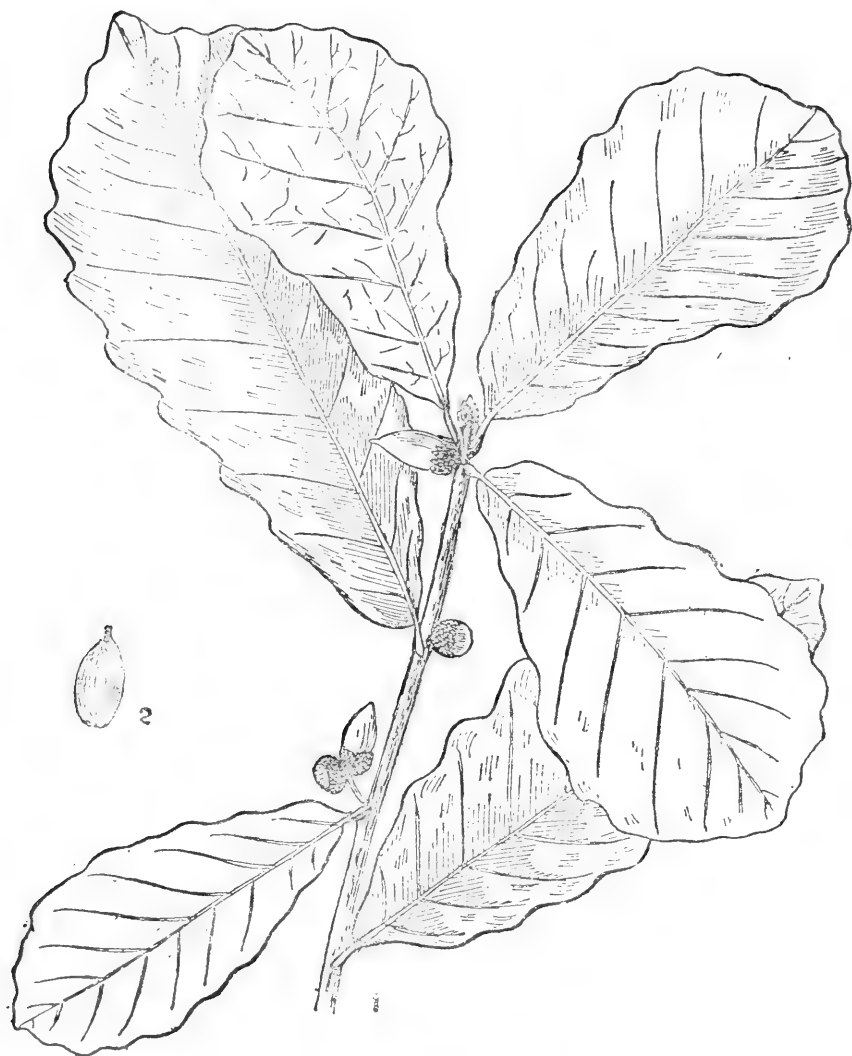


Plate 34. *QUERCUS FABRI* Hance

1. Fruiting branch ; 2. Acorn.

solitary or in pairs. Acorns oblong or acute, about 2 cm. long; cupule hemispherical, embracing about $1/3$ of the nut, with lanceolate, light chestnut brown, convex scales.

West, Central & South China. (Hupeh, Szechuan, Chekiang, Kiangsu, Kwangtung). The leaves are characterized by being prominently reticulated beneath.

***Quercus aliena* Blume.**

Tree 16 to 20 m. tall or taller. Branchlets glabrous. Leaves oblong obovate, rounded or slightly acute, broadly cuneate or rounded at base, shallowly sinuate with broad, rounded teeth, glabrous above, densely white tomentose beneath, 10 to 20 cm. long; petiole under 10 mm. long. Fruit 1-3, subsessile or short stalked. Acorn ellipsoid or oblong, 2-2.5 cm. long. Cup embracing about $1/2$ the nut, scales thin and acuminate.

Western & Central China to Korea and Japan.

A very variable species, with forms particularly marked in the var. *acutiserrata* Maximowicz described as having leaves with acute gland-tipped teeth. For the average student, however, these inconstant characters are hardly worth considering for all practical purposes.

***Quercus dentata* Thunberg.**

Tree 20-25 m. tall, with dark gray, deeply furrowed bark. Buds and young shoots tomentose. Leaves large, 20-30 cm. long, 8-18 cm. wide, obovate, acute or rounded at the apex, cuneate or subcordate at the base, deeply and serrately 5-9 lobed, dark green, glabrous above, light green with stellate pubescence below. Fruit almost sessile, clustered. Acorn ovate or subglobose. Cupule with thin, lanceolate, reflexed, chestnut brown scales, enclosing about $1/2$ of the nut which ripens in 1 year.

Mongolia, China to Japan. (Hupeh, Szechuan, Yunnan, Shantung, Kiangsu, Chekiang, Kiangsi & Chihli).

It occurs on poor soils on the low hills of the Northern provinces, according to Henry. Very commonly planted about temples, burying grounds and parks. This is an important silkworm tree. The wood is coarse grained and brittle. The bark is valuable and much used in Japan for tanning.



Plate 35. *QUERCUS ALIENA* Blume

1. Sterile branch. 2. Under side of leaf; 3. Fruit; 4. Staminate flower; 5. Cupules; 6. Seed; 7. Pistillate flower. (Details enlarged.)



Plate 36. QUERCUS DENTATA Thunberg

***Quercus glauca* Thunberg.**

Evergreen tree to 20 m. tall. Branchlets at first pubescent, later glabrous or nearly so. Leaves coriaceous, lanceolate or elliptic-oblong to ovate-oblong, acuminate, broadly cuneate or slightly rounded at the base, mucronate, serrate in the upper half of the margin, lustrous green above, glaucous and silky hairy beneath when young, 8-13 cm. long; petiole slender, 8-25 mm. long, glabrous or with scattered hairs. Fruit ripening in one year, 1-3 together, short stalked. Acorn longer than broad, ovoid-conic to ellipsoid, acute, about 2 cm. long. Cup saucer shaped, about 12 mm. wide, silky tomentose, with 4-8 concentric rings having entire or crenate margins.

Widely distributed over Eastern Asia. Kiangsi, Hupeh, Szechuan, Chekiang, Yunnan and Fukien. The nuts are edible. The wood is greatly valued for construction.

A handsome, broad-topped, wide-spreading tree.

***Quercus semicarpifolia* Smith.**

Small evergreen or semi-evergreen tree to 15 m. tall, rarely taller. Bark dark gray, shallowly fissured into quadrangular plates. Young branchlets and buds rusty tomentose. Leaves holly-like, coriaceous, elliptic to elliptic-oblong or obovate-elliptic, rounded or slightly cordate at the base, entire or dentate with spinescent teeth, dark green and glabrous above, usually hairy beneath, 5-13 cm. long; petiole very short. Staminate catkins fascicled, 5-15 cm. long; pistillate spike short, few flowered; style 3-5, linear, recurved. Fruit ripening in 2 years, solitary, rarely in pairs. Acorn globular, 2.5 cm. in diameter, smooth, black when ripe. Cup shallow, thin with ovate scales which are free at the apex.

India to Western China.

On arborescent specimens the leaves are more often entire. This species, however, usually occurs in scrub growth. The wood is very hard, said to make excellent charcoal.

***Quercus aquifolioides* Rehder & Wilson.**

Evergreen shrub or tree to 8 or 9 m. tall. Branchlets glabrous. Leaves leathery, subsessile, oval, elliptic or ovate-elliptic, with a subcordate or auriculate base, spiny pointed with slightly revolute margin,



Plate 37. QUERCUS GLAUCA Thunberg



Plate 38. *QUERCUS SEMICARPIFOLIA* Smith

1. Fruiting branch; 2, 3. Showing variation of leaves; 4. A stellate hair; 5. Staminate flower. (4 and 5 enlarged.)

or entire, lustrous above, densely yellowish-brown tomentose beneath, 3-8 cm. long. Pistillate flowers in erect, axillary spikes; styles 3, recurved; staminate ament pubescent; flowers remote, perianth 5 lobed, stamens 5 with ovoid anthers. Fruit maturing in 2 seasons, 1-5 together, peduncled, in an erect spike; acorn ovoid, apiculate, about 12 mm. long; cup saucer-shaped, slightly over 6 mm. high, pilose on the inner surface; scales free, linear-lanceolate, brown, slightly fringed at the margin.

W. Szechuan.

Closely allied to *Q. semicarpifolia*, from which it differs by the acorn, which is not ovoid, and not globular, and by the biennial fruitification. It occurs in association with *Q. semicarpifolia*.

Quercus gilliana Rehder & Wilson.

Evergreen shrub or small tree to 6 m. tall. Branchlets purplish-brown, at first pilose, finally glabrescent. Leaves coriaceous, subsessile, oval to obovate, apex rounded, spiny pointed, base subcordate to slightly auriculate, sinuately spiny-toothed, quite glabrous at maturity, 12 mm. long. Fruit 2-4 together, subsessile, ripening in one season; acorn ovoid, cup hemispherical with triangular-ovate, glabrescent, scales enclosing nearly 1/2 of the nut.

W. Szechuan.

Distinguished from *Q. semicarpifolia* by the fruit, which is not globular and embraced nearly 1/2 by the hemispherical cup. This species usually occurs as scrub over large areas.

Quercus oxyodon Miquel.

Half evergreen tree up to 10 m. tall. Winter buds angular with gray, acute, mucronate scales. Leaves oblong, acuminate, serrate, rounded or broadly cuneate at the base, with numerous prominent, close, deeply impressed lateral veins, glaucescent and silky pubescent beneath, 6-1 cm. long. Fruit ripening in 1 year, spicate, sessile; acorns ovoid to subglobose, about 2 cm. long, broader than high; cup saucer-shaped with several irregular, crenulate, concentric rings which are grayish tomentose and not deeply appressed.

Hupei, Szechuan to India.

Common in Western China. The leaves persist through the winter and are replaced by the new leaves in the spring.

***Quercus phillyræoides* Gray.**

Evergreen shrub or tree up to 8 m. tall. Leaves coriaceous oval to oblong-ovate, crenately serrate above the middle, occasionally entire; dark green, glabrous, 2-4 cm. long. Fruit ripening in 2 years, short peduncled; acorn oblong-elliptic; cup small, with short, closely appressed scales.

Hupei, Szechuan and Fukien, Japan. Usually occurs as a dense bush.

***Quercus myrsinæfolia* Blume.**

Evergreen tree to 16 m. tall. Leaves lanceolate or oblong-lanceolate, acuminate, cuneate at the base, serrate, lustrous green above; glaucous and glabrous beneath, 8-13 cm. long, 2-4.5 cm. wide. Fruit spicate; acorn oblong-ovoid 1.2-2 cm. long; cup glabrous with 6 concentric rings, embracing $\frac{1}{3}$ of the nut.

Hupei, Szechuan, Yunnan, Hongkong and Japan.

***Quercus spinosa* David.**

Evergreen shrub, occasionally small tree up to 10 m. tall with pendent branchlets. Young leaves densely tomentose or nearly glabrous, always glabrous at maturity except on the lower half of the midrib, beneath which is clothed with dense gray hairs. Leaves dark green densely bullate, usually entire, occasionally coarsely spiny-dentate. Fruit pedunculate, maturing in 2 seasons.

Hupei and Yunnan.

***Quercus spathulata* Seemen.**

Evergreen trees up to 13 m. tall. Leaves coriaceous, usually quite entire, shiny green above, glabrous or clothed with short curly pubescence beneath. Fruit ripens the 2nd year, short-stalked; cup mossy, with linear, recurved scales.

Hupei and Szechuan.

Scattered over a wide area.

***Quercus engleriana* Seemen.**

Evergreen tree of medium size, not over 10 m. tall. Branchlets brown, tomentose when young, finally glabrous. Leaves obovate-oblong,

acuminate, rounded at the base with a few small, spiny appressed teeth, sometimes entire, 6-13 cm. long. Fruit ripening in 1 season, 1-3 together, short stalked; acorn ovoid, 2 cm. long or slightly less; cupule cup-shaped with thin, nearly glabrous scales.

Hupeh and Szechuan.

Always a small tree common in rocky places. Introduced into Europe and America for ornament. In Japan it is planted for hedges. Often confused with *Q. glauca*.

Q. acrodonta Seemen.

Tree 5 m. tall. Confined to Hupeh and very rare, may prove to be only a variety of *Q. phillyraeoides*.

Q. baronii Skan.

A semi-evergreen shrub with membranous, spinescent leaves and a biennial fruit in a cup with recurved linear scales, resembling that of *Q. spathula*.

Q. griffithii Hooker f. & Thompon.

Tree 3 m. tall. Closely related to *Q. aliena*, from which it is distinguished by the pubescent branchlets and the slightly fringed cup.

Yunnan.

Quercus bambusifolia Hance.

A very distinctive species with dark purplish branchlets, usually entire lanceolate leaves and a large fruit ripening the second year.

S. China.

Quercus vestita Rehder and Wilson, Yunnan; *Q. delavayi* Skan, Yunnan; *Q. schottkyana* Rehder and Wilson, Yunnan, are other species of minor importance.

ULMACEAE

Leaves alternate, stipules caducous. Flowers dioecious or monoecious. Perianth single, persistent, campanulate. Ovary free, 1-2 celled; styles 2. Fruit a samara or a drupe, 1 seeded, exalbuminous.

13 genera and about 140 species widely distributed over the temperate and tropical regions. Of the 13 genera, 7 woody genera occur in China. Several members of this family are in cultivation for timber and ornament. *Celtis* is the largest genus, with 60 species.



Plate 39. QUERCUS BAMBUSIFOLIA Hance

KEY TO GENERA

- I. Fruits drupaceous; flower on the current year's shoots.
 - A. Sepals connate; style eccentric; fruit oblique.
 - 1. Branchlets armed; leaves dotted with minute circular black depressions; fruits winged.....*Hemiptelea*.
 - 2. Branchlets unarmed; leaves without minute dots; fruit not winged.....*Zelkova*.
 - B. Sepals distinct or nearly so; style central; fruit globose.
 - 1. Drupe winged; wing somewhat woody.....*Pteroceltis*.
 - 2. Drupe not winged.
 - a. Fertile flowers unisexual; leaves with straight veins ending in the teeth.....*Aphananthe*.
 - b. Fertile flowers perfect; leaves with curved veins closed before reaching the margin.
 - (1) Leaves evergreen; flowers in cymes.....*Trema*.
 - (2) Leaves deciduous; pistillate flower solitary...*Celtis*.
 - II. Fruits not drupaceous, winged; samara membranous; flowers on last season's shoots, (except 1 species)*Ulmus*.

ULMUS

Mostly deciduous trees. Leaves 2 ranked, simple, alternate, serrate, pinnately veined with straight veins, oblique at the base, stalked, stipules 2. Flowers small, apetalous, perfect, rarely polygamous, in clusters or fascicles, appearing before the leaves in the spring, or in the axils of the leaves in the autumn; calyx persistent, bell-shaped, greenish or tinged with red, 4-9 lobed; stamens equal to and opposite the calyx lobes, exserted, inserted at the base of the perianth; ovary superior, usually 1 celled and 1 ovuled. Style 2-lobed. Fruit a membranous samara, with a flat orbicular or oval wing notched at the apex and surrounded at the base by the persistent calyx.

About 20 species in N. America, Europe, and Asia.

The wood is hard, heavy, and tough, much used in the wood-working industries. The inner bark is an ingredient in the composition of incense; it is also made into a mucilaginous meal, used as food by the

mountaineers of the northern provinces. Coarse cloth and ropes are woven from the inner fibers, which in Russia and China find a further use in the making of sandals. Several species are desirable for street and park planting, but unfortunately the elms are subject to attack by many fungous and insect pests.

***Ulmus japonica* Sargent.**

(*U. campestris* var. *japonica* Rehder.)

(*U. campestris* var. *major* Trautvetter.)

Tree to 30 m. tall with broad head, and light gray, shallowly fissured and fibrous bark. Branchlets somewhat pendulous, densely pubescent and rough with minute tubercles, yellowish or pale brown, sometimes with corky ridges. Leaves firm, rough on both surfaces at maturity, obovate, or elliptic, acuminate, oblique at the base, hairy above, pubescent beneath with tufts of hairs in the axils of the veins, and 12-19 pairs of lateral veins, 8-15 cm. long; petioles pubescent, 5 or 6 mm. long. Flowers subsessile, in parts of 4's. Fruit obovate-oblong, notched at the apex down to the nutlet, narrowed toward the base, almost entirely glabrous.

Manchuria, N. China to Japan.

(Chihli, Shantung, and Chekiang.)

The wood of this tree is brownish. It is durable in water, and is exported in large quantities from Japan. The tree sometimes assumes the characteristic vase-shaped form of the American elm, and it should be useful as a street tree on account of its rapid growth and ornamental character, as well as for its hardiness.

***Ulmus pumila* Linnaeus.**

Shrub or small, spreading or round-topped tree up to 15 m. high, with furrowed, scaly bark, slender pubescent branches and small, ovoid, pubescent buds. Leaves ovate to ovate-lanceolate, 3-12 cm. long, acute at the apex, nearly equal at the base, thin, membranous, dark green above, pubescent when young beneath, regularly and simply toothed. Flowers short stalked, in crowded clusters, 4-5 parted with yellow anthers, appearing in the spring. Fruit obovoid, notched deeply at the apex; nutlet central, reaching close to the base of the notch.

From N. China to E. Siberia.



Plate 40. *ULMUS PUMILA* Linnæus

1. Flowering branch ; 2. Sterile branch ; 3. Fruiting branch ; 4.
Flower, enlarged.

This tree is common around Peking, where fine old specimens may be seen in the grounds of the Temple of Heaven.

***Ulmus parvifolia* Jacquin.**

Half evergreen tree up to 20 m. tall or shrubby. Bark gray somewhat scaly, on old trees peeling off in roundish flakes, exposing the brown inner bark beneath. Branches numerous, spreading; branchlets pubescent. Leaves subcoriaceous, ovate to obovate or oblong, acute or somewhat obtuse, slightly oblique at the base, simply serrate, shiny green, glabrous above, pubescent beneath when young, usually glabrous at maturity, 2-5 cm. long; petiole very short. Flowers clustered, short pedicelled; stamens 4-5, long exserted. Fruit oval to elliptic, emarginate at the apex with the nutlet in the center of the wing, 9-13 mm. long.

China, Korea, and Japan.

(Hupeh, Shensi, Chihli, Kiangsu, Fukien, Formosa).

An interesting species flowering late in the summer, unlike all other Chinese species, which flower in the spring before the opening of the leaves. In the warmer temperate regions the leaves are retained through the winter and are shed when the new leaves come out in the spring. In the autumn the foliage turns brilliantly red and yellow. The grayish scaly bark distinguishes this from all other elms.

***Ulmus macrocarpa* Hance.**

Densely branched shrub or small tree up to 9 m. tall. Branchlets pubescent, later pale brown, with somewhat flattened corky wings. Leaves ovate, coarsely and doubly serrate, rough above, pubescent and hairy beneath. Flowers 5-9, clustered. Samara obovate, pubescent and ciliate, with the nutlet in the center of the wing, about 2.5 cm. long.

Chihli and Shansi.

This elm grows in dry rocky situations and is fairly common in Chihli. It has been introduced into cultivation in America.

***Ulmus laciniata* Mayr.**

Shrub or small tree. Branchlets gray-brown. Leaves obovate, usually 3-5 lobed at the apex with very unequal, semicordate base, rough on the upper surface. Fruit elliptic, 2 cm. long.

N. China and Japan.



Plate 41. *ULMUS LACINIATA* Mayr

1. Flowering branch; 2. Sterile branch; 3. Flower, enlarged.

CELTIS

Tree or shrub. Leaves simple, alternate, stalked, serrate or entire, 3-5 nerved at the base, slightly oblique. Flowers small, apetalous, polygamo-monoecious; staminate clustered, in fascicles at the lower part of the branches; pistillate flower single, on the axil of the leaves on the upper part of the branches; calyx 4-5 lobed; stamens 4-5, exserted in the staminate flowers, included or absent in the pistillate flowers. Ovary sessile, 1 celled. Style 2 lobed. Fruit a fleshy drupe; stone thick-walled and bony, 1 seeded and with a thin flesh which is edible in some species.

About 50 species widely distributed in the temperate and tropical regions. The species are chiefly useful for ornament, although the wood, which is light and soft and easily split, is often used for the manufacture of furniture and utensils. The Chinese species require thorough study before a true conception of the genus is possible.

***Celtis bungeana* Blume.**

Small tree with flattened or rounded crown, 10-15 m. high. Bark smooth, light gray. Branchlets glabrous. Leaves about 6 cm. long, ovate or ovate-lanceolate, acuminate, rounded at the base, upper half of the margin serrate or sometimes nearly entire, the margin at the base always entire, dark green, shiny above, light green on the lower surface. Petioles slender, about 7 mm. long. Fruit purple-black, small; pedicels slender, but longer than the petioles of the leaves. Stone smooth, white and almost globular.

China and Korea.

(Hupeh, Szechuan, Yunnan, Shensi, Shantung and Chihli.)

Distinctly characterized by glossy green foliage and a black fruit with smooth, white stone.

***Celtis sinensis* Persoon.**

(*C. japonica* Planchon.) Chinese Hackberry.

Tree to 10 m. tall with smooth gray bark. Leaves ovate, to oblong-ovate, to ovate-lanceolate, rounded or subcordate, unequal at the base, acuminate, serrate-dentate, pubescent on both faces when young, gray-green or glaucescent and reticulated beneath, 5-10 cm. long. Fruit



Plate 42. *CELTIS BUNGEANA* Blume

1. Fruiting branch; 2. Fruit.

dull orange-red; stone smooth or more or less irregularly pitted and ribbed; peduncle rather stout, as long as or slightly longer than the petioles.

China, Korea, and Japan.

(Kwangtung, Hongkong, Formosa, Kiangsu).

A common species.

***Celtis biondii* Pampinini.**

Tree to 13 m. tall. Leaves ovate-oblong, 2-2½ times longer than broad, margin entire or somewhat dentate with acute teeth, brownish beneath, veins impressed, not prominent. Fruit orange, small.

Hupei, Szechuan, Kiangsi and Kiangsu.

This tree has been recorded from the Spirit Valley in Nanking.

***Celtis julianae* Schneider.**

Tree up to 25 m. tall with smooth, light gray bark. Young branchlets angled, densely yellowish tomentose, later glabrous and blackish, marked with numerous lenticels. Flower-buds reddish-brown, obtuse, with hairy scales. Leaves very much thickened, oblique, broadly ovate, obovate or obovate-elliptic, apex acuminate, base unequal, bright green and minutely hairy along the veins above, gray-green, prominently reticulated and pubescent beneath, crenate dentate, sometimes nearly entire, 6-14 cm. long, about 6 cm. wide. Petiole thick, furrowed above, tomentose. Staminate flowers cymose at the base of the current year's shoots, 5-merous, calyx-lobes free, ovate-lanceolate; stamens 5, inserted on a hairy disk; pedicel short, hairy; pistillate flowers solitary, axillary, on the apex of the flowering branch, usually 4-merous; ovary glabrous; stigmas 2, elongated, hairy. Fruits orange, ovate-globose, glabrous, about 12 mm. long; peduncle stout, pubescent.

W. Hupei.

Said to be common within its range.

PTEROCELTIS

Deciduous tree in foliage and habit resembling *Celtis*. Branchlets glabrous. Buds small with reddish-brown ciliate scales. Leaves alternate, petioled, 3-nerved, simply, sharply and irregularly serrate

except at the base, glabrous, dull green above, lighter green beneath, veins impressed and not prominent. Flowers monoecious; staminate calyx 5-parted; stamens 5.

Pistillate flower solitary in the axils of the season's shoots, appearing in March and April; pedicels distinctly but sparsely pilose; calyx lobes 4, lanceolate, greenish, slightly pilose, scarcely longer than the ovary; ovary sessile, elliptic-rounded, laterally compressed, sparsely pilose; stigmas 2, lanceolate, divergent. Fruit a winged nut, solitary, axillary, on a slender pedicel; wing thick, more or less square or broader than long, or suborbicular, emarginate below and above the nut; nut *Celtis*-like, usually crowned by the remnant of the style.

The genus includes a single species closely resembling *Celtis* but distinguished from it by the winged nut.

Pteroceltis tartarinowii Maximowicz.

(*Ulmus cavaleriei* Laveille.)

Tree 16 m. tall with characteristic pale gray bark peeling off in irregular long flakes. Leaves 4-9 cm. long. Fruit up to 13 mm. long; pedicel 2.5 cm. long or more.

Hupei, Szechuan, Shensi, Chihli, Shantung, Kweichow.

APHANANTHE

Deciduous trees or shrubs. Leaves alternate, 2-ranked, serrate, petiolate and stipulate. Flowers monoecious, small and inconspicuous; staminate numerous, in axillary cymose clusters at the base of the twigs; sepals and stamens 5. Pistillate solitary, axillary; ovary 1 celled and 1 ovuled; styles 2. Fruit a drupe.

About 3 species in E. Asia and Australasia. They resemble *Celtis*, but may be distinguished by the unisexual flowers and the leaves having straight veins ending in the teeth. In *Celtis* the veins curve and unite near the margin.

Aphananthe aspera (Thunberg) Planchon.

Tree to 20 m. tall. Leaves ovate, to ovate-oblong, long pointed, cuneate or rounded, more or less oblique and 2 nerved at the base, parallel veined with the veins ending in the teeth, rough and hairy on



Plate 43. *PTEROCELTIS TARTARINOWII* Maximowicz

both sides, bright green above, 3-10 cm. long, on a very short stalk. Flowers appear with the leaves, greenish. Fruit an ovoid or globose drupe, purple-black, about 8 mm. long with more or less persistent styles.

Korea, Japan and China. (Kiangsu, Kiangsi, and Kwangtung.)

ZELKOVA

Deciduous unarmed trees or shrubs. Leaves simple, alternate, 2-ranked, pinnately veined, serrate, short stalked, stipulate. Flowers polygamo-monoecious; pistillate solitary, in axils of upper leaves; staminate, 2-5 in the axils of the lower leaves; apetalous; calyx lobes 4-5; stamens 4-5; ovary sessile; styles 2. Fruit a small drupe, subglobose, oblique; style persisting as 2 minute beaks; 1-seeded. The fruits persist on the tree till the following spring.

About 4 species in Eastern Asia, Caucasus, Crete.

Zelkova yields the highest-priced lumber of any tree in Japan. The wood is beautifully grained, resembling the elmwood in structure, is as tough and pliable as the ash and more durable than the oak in contact with the soil. The sapwood is white and narrow, separated from the brown heartwood by a reddish band. On account of its beautiful markings as well as its susceptibility to a high polish, the wood is used in Japan for fancy trays, lacquer ware, high grade cabinets and other furniture. It is also suitable for house, ship, and carriage building.

For posts, pillars, and gateways it is unsurpassed by any other wood in durability. *Zelkova* is very rapid growing and attains 100 feet in height or more; trees, on moderately favorable situations, measuring 5 feet in girth at 60 years, 9 feet in girth at 120 years, cannot be said to have made phenomenal growth. On deep alluvial soil, the rate of increase is even more rapid. *Zelkova serrata* is one of the most important hardwoods available to Chinese foresters for experimentation, and its extensive cultivation is likely to promise results of great practical value. On account of its tendency to form side branches, *Zelkova* should be subjected to a certain amount of crowding when young. The seedlings stand considerable shade.

An ounce contains between 20,000 and 25,000 seeds. Germination sets in 4 or 5 weeks after sowing, although some of the seeds do not germinate until the second year. The seeds are sown in well prepared

beds and are given half shade during the first year. After one transplantation, the seedlings are ready to be set out in the permanent field.

***Zelkova serrata* Makino.**

(*Zelkova acuminata* Planchon.)

(*Zelkova keaki* Maximowicz.)

(*Zelkova hirta* Schneider.)

(*Zelkova sinica* Schneider.)

Tree up to 30 m. tall with pale gray bark peeling off in small round flakes. Branches slender. Leaves ovate to oblong-ovate, acuminate, rounded or slightly oblique or broadly cuneate at the base, coarsely and sharply serrate with blunt or apiculate teeth, green, somewhat rough and sparsely pilose, with impressed veins above, pubescent or hairy only along the veins and grayish-green beneath; 2.5-6 cm. long; on sterile branches sometimes up to 12 cm. long. Fruit irregular rhombic, or ovoid, glabrous, about 5 mm. long and broad, with the persistent, 5-lobed calyx at the base and 2 incurved stigma set obliquely upon the apex.

China and Japan.

Hupei, Shensi, Chekiang, Kiangsu, Anhwei.

With extensive material before me, I am unable to distinguish *Z. sinica* Schneider from *Z. serrata* Makino.

An edible mushroom sometimes grows on the wood of this tree.

HEMIPTOLEA

Deciduous tree with spinescent branches. Leaves alternate, 2-ranked on the branches, ovate, pinnately veined, short stalked, somewhat oblique at the base, acute, crenate serrate, stipules deciduous. Flowers perfect, pedicelled, 1-4 in a fascicle on branches of the current year's growth. Perianth cup-shaped to campanulate, 4-5 lobed; stamens usually 4, opposite the calyx lobes, inserted near the base of the perianth. Fruit a half winged nutlet surrounded at the base by the persistent perianth, obliquely conical, enlarged at the base, produced into a short horny beak; the unevenly toothed wing attached near the apex. Ovule single.

Only 1 species described, closely related to, and by some authors included under *Zelkova*, which it resembles in foliage and habit but from which it may be distinguished by the thorny branchlets, by the winged fruit and by internal structure.



Plate 44. ZELKOVA SERRATA Makino

1. Staminate branch; 2. Fruiting branch; 3. Pistillate flower; 4. Staminate flower; 5. Fruit; 6. Leaf, showing variation in size. (3, 4 & 5 enlarged.)

Hemiptelea davidii (Hance) Planchon.

(Zelkova davidii (Hance) Hemsley.)

(Planera davidii Hance.)

Small tree. Branchlets reddish-brown. Leaves 2-6 cm. long, elliptic-oblong to oval, acute, cuneate or subcordate at the base, coarsely dentate-serrate; upper surface dark green, covered with scattered deciduous hairs, each hair inserted in a dark, minute, circular depression; lower surface generally smooth. Fruit about 6 cm. long.

North and Central China and Korea.

TREMA

Evergreen shrubs or trees. Leaves alternate, 3-nerved, or pinnately veined, serrate, short petioled. Flowers monoecious or dioecious, in almost sessile clusters, small, apetalous, 5 (rarely 4) merous; stamens 4-5; ovary 1 celled; stigmas 2, united below into a single style. Fruit a small drupe with a pitted stone.

About 30 species in the tropical and subtropical regions.

Trema virgata Blume.

Tree to 10 m. tall with small, narrow, lanceolate leaves.

Hupei, Szechuan, Yunnan, Hainan.

MORACEAE

Trees or shrubs mostly with milky juice. Leaves alternate, simple, with petioles and stipules. Flowers monoecious or dioecious, in ament-like clusters, or heads, apetalous; calyx 4-6 parted; stamens 1-4; ovary 1-2 celled, superior; style simple or 2 lobed. Fruit aggregated, inclosed in the thickened calyx of the flower, forming a compound fruit.

About 55 genera and 1,000 species widely distributed in the warmer regions. This family includes many members of great economic importance. Among the more important genera, *Artocarpus integrifolia* (Jack Fruit) is cultivated in Kwangtung and is wild or naturalized in the Island of Hainan. *Ficus elastica* (Rubber tree) is cultivated in China, in Hainan. *Cannabis sativa* (Hemp) and *Broussonetia papyrifera* yield fibres suitable for making cloth and paper. *Ficus carica* is the cultivated



Plate 45. *HEMIPTELEA DAVIDII* Planchon

1. Flowering branch; 2. Fruiting branch; 3. Sterile branch, showing thorn; 4. Fruit; 5. Pistillate flower with perianth removed; 6. Staminate flower; 7. Pistillate flower; 8. Stamen. (Details enlarged.)

fig; other species of *Ficus*, particularly *F. retusa* Linn. known as Banyans, become large trees. The arborescent genera occurring in China are: *Morus*, *Broussonetia*, *Ficus* and *Cudrania*.

The Chinese species of *Ficus* need thorough study and revision. Although some members attain a large size and are prominent features in the landscape, especially in the vicinities of villages in S. China, they are of little economic importance, producing wood of no value, and their description will be omitted in this work, but for the sake of completeness the distinguishing characters of the genus are included in the following key.

Most members of this family may be recognized by the alternate leaves and by the milky sap which the bark exudes when cut.

KEY TO GENERA

- A. Flowers on the outside of the receptacle; buds scaly.
 - I. Anthers reversed with incurved filaments in the bud.
 - a. Both staminate and pistillate flowers in spikes; compound fruit oblong and succulent.....*Morus*.
 - b. Pistillate flower capitate; compound fruit composed of numerous druplets protruding from a globose head
.....*Broussonetia*.
 - II. Anthers erect even in the bud, pistillate flower in a globose head; fruit globose in a hard, rather smooth rind.....*Cudrania*.
- B. Flowers enclosed in a fleshy receptacle becoming a succulent sub-globose or ovoid or pyriform compound fruit.....(*Ficus*.)

MORUS

Deciduous trees or shrubs. Leaves simple, stalked, serrate, entire or variously lobed, palmately 3-5 veined. Flowers apetalous, dioecious or monoecious, in solitary catkins; staminate spike elongated, calyx 4 lobed, partially enclosing the 4 stamens which uncoil like a spring when the pollen is shed. Pistillate spike, short; ovary sessile, 1 celled; style divided nearly to the base into 2 stigmas; each ovary enclosed in the calyx which becomes thick and fleshy, surrounding the real fruit which is a compressed achene. The fleshy covering of the achenes cohere, forming a multiple fruit, not unlike the blackberry in appearance. The fruit is sweet and edible.

About 10 well defined species in the temperate regions of Europe, Asia and America. The mulberries have been under cultivation for a long time. Easily propagated by cuttings taken in the summer. The mulberries are cultivated either for their leaves, which form the best food for the silkworms, or for their fruit, which is eaten fresh or expressed for the juice, which enters into the composition of cooling beverages and certain medicines. The wood is handsome, light brown or orange colored, straight grained, strong and durable, used for furniture, agricultural implements and boat building.

The mulberries are propagated by seeds and the varieties by grafts. The seeds of *Morus alba* average 250,000 per lb. The germinative capacity ranges from 24 to 28%. The seeds germinate in about 25 days after sowing.

***Morus alba* Linnaeus.**

White Mulberry.

Tree 10 to 15 m. tall, with rounded head, gray or grayish-yellow branches and thick, furrowed bark. Young shoots pubescent. Leaves very variable, undivided, indented or 3-lobed, or occasionally compoundly lobed on sprouts and young shoots; coarsely and irregularly toothed, shining green above, dull green, pubescent on the midrib and veins below; petiole 2-4 cm. long. Pistillate catkins on long stalks, 5-12 mm. long. Fruit very variable in size, 1-5 cm. long, white, violet or reddish.

The White Mulberry occurs wild in the mountainous districts of the Central and Northern Provinces of China. All varieties are cultivated for their leaves, upon which the silkworms are fed. The bark of the roots yields a medicine valued in the Chinese Materia Medica. The wood is used for cabinet-work, musical instruments, carving and turnery. In Japan a hand-made paper is manufactured from the bark.

***Morus acidosa* Griffith.**

Usually a shrub; rarely a small tree up to 6 m. tall. A widely distributed and distinct species with a prominent style and shiny black fruit which is edible. The leaves are not fed to silkworms. (Wilson).

China, Korea and Japan.

(Chihli, Hupeh, Szechuan, Kweichow, Yunnan, Kwangtung and Formosa.)



Plate 46. MORUS ALBA Linnæus

1. Staminate branch; 2. Pistillate branch; 3. Fruiting branch; 4. Ovary; 5. Staminate flower. (4 and 5 enlarged).

BROUSSONETIA

Deciduous trees or shrubs. Leaves alternate, stalked undivided or 3 lobed, rarely 5 lobed, serrate, 3 nerved at the base. Flowers dioecious or monoecious, apetalous. Staminate in cylindric or globose catkins, calyx 4 parted; stamens 4, exerted at maturity. Pistillate flowers in a globose head, composed of the compact, persistent, villose or tomentose perianth and bracts; perianth tubular, 3-4 toothed; ovary included, stalked; style, single, filiform, stigmatic to the base or nearly so. At maturity the fruiting head is globular, consisting of numerous 1-seeded, orange-red, drupelets.

3 species in E. Asia and the Pacific Islands; 2 in China.

Broussonetia papyrifera (L.) L. Heritier.

(*Morus papyrifera* Linnaeus.)

Tree up to 16 m. high, with broad, round-headed crown. Bark dark gray and smooth. In cultivation, more commonly a vigorous shrub with stout, spreading, pubescent branches. Leaves 7-20 cm. long with stalk 2.5-8 cm. long, coarsely toothed, somewhat oblique and cordate at the base, acuminate, often deeply 3 or 5 lobed, rough and dull green above, pubescent below. Mature fruiting head about 15-20 mm. across, brick red.

Native of China, introduced into Japan, and to Europe in the 18th century. (Chihli, Szechuan, Hupeh, Yunnan and Formosa).

The bark of *Broussonetia* is used for paper making. Authorities are inclined to believe that the use of paper mulberry fibers for paper, antedated the use of the pith from the bamboo.

Broussonetia kaempferi Siebold.

Is known only as a shrub 3 to 5 meters high. It has small, pubescent, short-petioled leaves and very small fruits.

Hupeh, Yunnan, Chekiang, Korea, Japan.

CUDRANIA

Trees or shrubs, often armed with thorns. Leaves deciduous, alternate, pinnately veined, with stipules. Flowers dioecious, apetalous, crowded in a globular head; sepals and stamens 4; ovary solitary, 1 celled, 1 ovuled. Fruit globose, with a hard, shiny rind.

3 species in S. & E. Asia and Australasia.



Plate 47. BROUSSONETIA PAPYRIFERA L. Heritier

1. Staminate branch; 2. Fruiting branch; 3. Pistillate branch; 4. Staminate flower; 5. Pistillate flower sectioned; 6. Stamen. (4 and 6 enlarged).

Cudrania tricuspidata (Carr.) Bureau.

(C. triloba Hance.)

(Maclura tricuspidata Carriere.)

Shrub or tree to 13 m. tall. Bark pale gray, flaky. Branches thorny. Leaves oval, obovate to elliptic-ovate, entire or slightly 3 lobed at the apex, acuminate, dark green, slightly pubescent below, 4-10 cm. long. Capitate inflorescence about 8 mm. in diameter, axillary, solitary or in pairs, on a tomentose peduncle about 6 mm. long; flowers greenish. Fruit red, globose, about 2.5 cm. in diameter.

China, Korea and Japan. The leaves of this tree are fed to young silkworms. The fruit is sweet and edible. Small articles are made from the wood.

Cudrania javanensis Trecul.

Shrub, rarely tree, to 3 m. tall. Widely distributed and a variable species.

Fukien, Yunnan, Formosa, Philippine Islands, and India.

URTICACEAE

Herbs, shrubs or trees, rarely climbers. Leaves alternate or opposite. Flowers dioecious or monoecious or polygamous, apetalous, regular, clustered; calyx 4-5, rarely 2-3 cleft or parted; stamens as many as and opposite the perianth lobes, the filaments inflexed, uncoiling elastically like a spring; ovary superior, rarely united with the calyx, 1 celled, 1 ovuled, style 1; stigma capitate, penicellate or feathery. Fruit an achene or drupe.

About 41 genera and 500 species widely distributed over the tropical and temperate regions.

Behmeria nivea Gaudichaud, a shrub commonly cultivated for its fibers, belongs to this family.

DEBREGEASIA

Shrubs or trees. Leaves alternate, 3-nerved at the base, short petioled; stipules bifid. Flowers monoecious or dioecious in globose clusters; staminate with a 4-parted perianth and 4 stamens; pistillate with an ovoid or oblong perianth much contracted at the mouth, and a

penicellate (tufted like a hair brush), sessile, or nearly sessile stigma. Fruit berry-like, composed of numerous small, 1-seeded achenes cohering by their fleshy coat into a globose head.

5 or 6 species from Abyssinia to Japan. 2 species in China.

Debregeasia longifolia Weddell.

Shrubs or tree to 10 m. tall. Branchlets with gray, silvery hairs. Leaves lanceolate to lanceolate-oblong, acuminate, serrulate, green, rough and rugose above, silvery gray and tomentose beneath, 10 to 18 cm. long. Flower heads in small, 2-branched cymes. Fruit orange yellow, about 8 mm. in diameter.

India to China. Hupeh and Yunnan.

Debregeasia edulis Weddell.

Shrub. Leaves oblanceolate to elliptic, rugose and smooth above, 8-13 cm. long.

E. China and Japan.

TROCHODENDRACEAE

Trees or shrubs with alternate leaves without stipules and solitary or clustered flowers; flowers perfect or unisexual, monoecious, without perianth or apetalous; stamens 4 or numerous and spirally arranged; carpels 2 to many, sometimes partly enclosed in the receptacle, with 1 to indefinite ovules in each carpel. Fruit winged and indehiscent or an unwinged, dehiscent follicle.

3 genera and about 7 species in E. Asia. *Trochodendron* is not recorded from China, but its occurrence in this country is not improbable, therefore the genus is included in the key in order to stimulate its discovery. For reasons already stated elsewhere (see remarks under Magnoliaceae) *Tetracentron* is tentatively included under the present family.

KEY TO GENERA

- I. Wood without true vessels; leaves alternate or whorled; flowers small, perfect in racemes; fruit not winged.

- A. Leaves alternate, palmately veined; racemes pendulous, sepals present, parts of the flowers in 4's; fruit a 4-celled, deeply lobed capsule.....*Tetracentron*.
- B. Leaves alternate or whorled, pinnately veined; racemes erect, without sepals or petals; stamens numerous, the anthers forming a ring; carpels 6-10 in a whorl and connate below with linear, spreading styles; fruit 6-10 follicles, inserted below in a fleshy receptacle, dehiscent at the apex (*Trochodendron*.)
- II. Wood with true vessels; leaves alternate; flowers perfect, proterandrous with numerous, conspicuous long, red, stamens; carpels many, ripening into obliquely winged fruits.....*Euptelea*.

EUPTELEA

Shrubs or small trees with dark brown, conspicuous winter buds. Leaves deciduous, alternate, simple, dentate, slender petioled. Flowers in the spring before the leaves, in axillary clusters on branches of last year's growth, without sepals and petals, perfect and proterandrous—the stigmas mature after the stamens have fallen away—fertilized by pollen disseminated by the wind; stamens indefinite, with large, red, linear anthers on short slender filaments; carpels many, oblique, on short stalks. Fruit a small, obliquely winged nutlet on a slender stalk, 1-4 ovuled.

3 species; 2 in China, 1 (*E. poylandra*) is confined to Japan.

Graceful ornamental trees propagated by seed and by grafts.

Euptelea franchetii van Tieghem.

Tree 12 m. tall. Leaves 5-10 cm. long, ovate, regularly or irregularly sinuate-serrate, slender petiolate, light green on both surfaces. Flowers usually with 12 stamens (7-20).

Carpels 6-12, long capitate, usually 2-3 seeded.

Central and Western China.

E. pleiosperma Hooker F. and Thompson.

(*E. davidiana* Hemsley.)

Leaves glaucescent and papillose on the under surface.

S. W. China and the Himalayas.

Closely allied to the above.

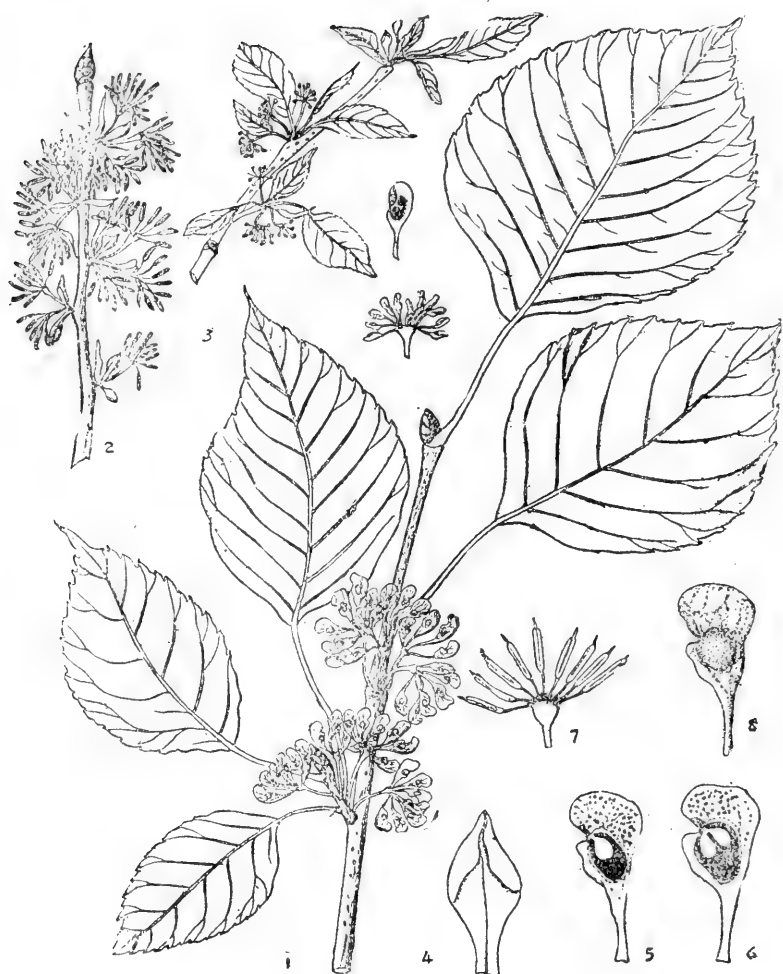


Plate 48. *EUPTELEA FRANCHETII* van Tieghem

1. Fruiting branch; 2. Flowering branch; 3. The same, later, the pistils enlarging after the stamens have matured; 4. Bract; 5, 6. Fruit sectioned; 7. Flower; 8. Fruit. (Details enlarged.)



Plate 49. *EUPTELEA PLEIOSPERMA* Hooker F. and Thompson

1. Fruiting branch; 2. Staminate branch; 3. Fruit; 4. Stamens;
5. Staminate flower. (Details enlarged.)

TETRACENTRON

Trees. Leaves deciduous, alternate, ovate-elliptic, short acuminate, obtuse or subcordate at the base, glandular-serrate, palmately 5-7 veined, petiolate, without stipules. Inflorescence a many flowered spike produced with a single leaf on the end of a short lateral spur. Flowers apetalous, perfect, small, yellowish, sessile with a 4 lobed perianth; stamens 4, opposite the petals and alternate with the carpels. Carpels 4, connate on the inner edge; styles 4, at first slightly recurved, then lateral and by the very oblique growth of the ovary, finally basal; ovules usually 4, pendulous. Fruit a deeply 4 lobed capsule, depressed at the apex, with the 4 styles persistent as short claw-like spurs at the base, loculicidally dehiscent, many on a pendulous spike.

A genus of 1 species superficially resembling *Cercidiphyllum* in habit and foliage and in the presence of short lateral spurs, but differing from it by the alternate leaves, the spiked inflorescence and by the 4 lobed, 4 spurred fruit.

Tetracentron sinense Oliver.

Tree to 30 m. tall. Leaves 10-15 cm. long, 7-9 cm. wide; petioles 2-3 cm. long. Flower spike slender, 7-10 cm. long. Fruit about 5 mm. or less long.

Szechuan, Hupeh, Shensi and Yunnan.

This is one of the largest trees in China. It grows best near water, as on the banks of streams. The wood is soft and brittle, of little known value.

CERCIDIPHYLLACEAE

Flowers unisexual, dioecious; stamens numerous, spirally arranged, on slender filaments. Carpels 2-5, stipitate, suture facing outwards, with indefinite ovules. Fruit many-seeded pods. Tree with roundish-cordate, *Cercis*-like leaves.

A family of only 1 species.

CERCIDIPHYLLUM

Tree with closely appressed, red-brown buds. Leaves deciduous, mostly opposite, occasionally alternate toward the base of the shoots,

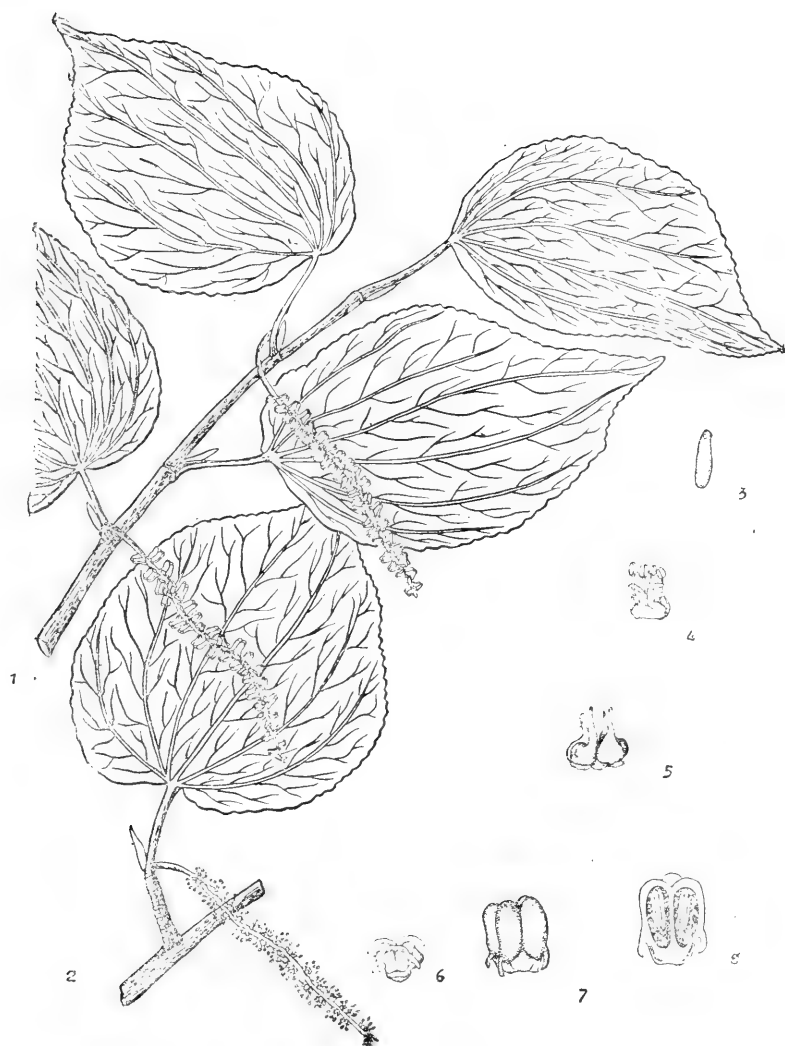


Plate 50. TETRACENTRON SINENSE Oliver

1. Fruiting branch; 2. Flowering branch; 3. Seed; 4. Flower; 5, 6. Different stages of maturing carpels; 7. Mature fruit; 8. Section of fruit. (Details from Hooker's "Icones Plantarum," Pl. 1892.)

ovate-cordate, margin entire or crenate, palmately veined and petiolate, purplish at the time of unfolding, later light green. Flowers dioecious, apetalous, inconspicuous. Staminate nearly sessile, with a minute calyx and an indefinite number of stamens on slender filaments; stamens 12 mm. long. Pistillate flowers on a short stalk, composed of a minutely 4-parted calyx and 3-6 carpels with elongated, slender, purplish styles. Ovules numerous. Fruit, small pods, 12-20 mm. long, 2-3 together on a short stalk, dehiscent at maturity. Seeds numerous.

One species, for a long time known only from Japan. A large, handsome ornamental tree, propagated by seeds sown in the spring or by green wood cuttings and by layering. A conspicuous feature of this tree is the lateral spurs on the branches, each bearing a pair of leaves or an inflorescence, the spurs being formed by short annual accretions extending over a period of years.

The number of seeds per pound is about 766,500. The period of germination is sometimes very rapid, sometimes very tardy, the sprouting period ranging from 20 days to 50 days after sowing.

***Cercidiphyllum japonicum* Siebold & Zuccarini.**

(*C. japonicum* var. *sinense* Rehder & Wilson.)

Tree usually with a single trunk, occasionally subdivided into several stems, attaining a height of 20-40 m. Leaves 5-10 cm. long, ovate or orbicular, crenate serrate or nearly entire, subcordate or slightly truncate at the base, pale green, glabrous above, pubescent along the veins below; petioles 2 cm. long. Pods 2-3 on a short peduncle, 10-15 mm. long, tapering toward the apex.

Western China: Shensi, and abundant in W. Szechuan and W. Hupeh. *Cercidiphyllum* is perhaps the largest deciduous tree in China. It thrives best in rich moist soils; frequently found on the banks of streams. It is rapid growing in youth, attaining great size and girth at maturity. The *Cercis*-like foliage turning red and yellow in the autumn, the small pod-like capsules and the spirally twisted, furrowed bark are characteristic of this tree. The wood is light, soft and straight grained, light brown, with the sap and heart woods showing a marked difference in color, used for furniture, general construction, wood carving, sketching boards and utensils.

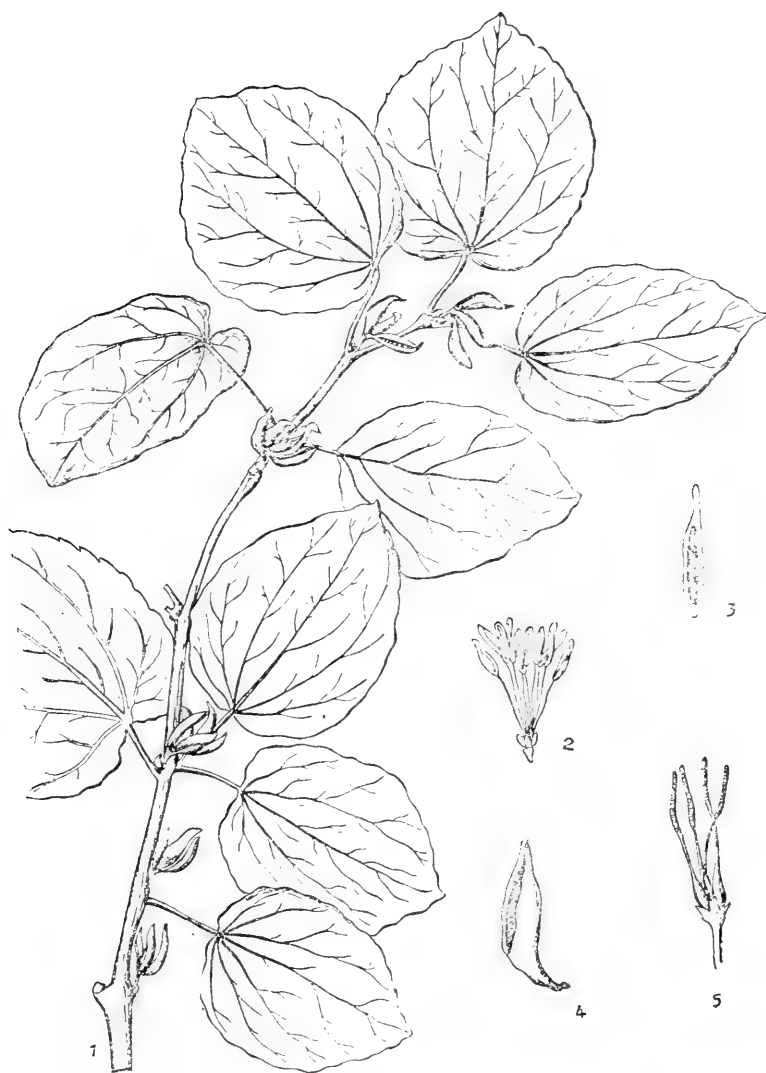


Plate 51. *CERCIDIPHYLLUM JAPONICUM* Siebold & Zuccarini

1. Fruiting branch ; 2. Staminate flower ; 3. Section of ovary ; 4. Fruit ; 5. Pistillate flower. (Details enlarged).

Although Rehder and Wilson have given a varietal name to the trees found in China, I can discover absolutely no botanical difference which separate these from the Japanese type and the varietal name is useless except as it may designate a geographical region. The Japanese form or race is said to grow more often with plural trunks.

MAGNOLIACEAE

Leaves alternate, with stipules. Sepals and petals in 3's or multiples of 3. Stamens and carpels numerous, spirally arranged. Fruit cone-like or fleshy, formed of the cohering carpels; ovules usually 2 in each carpel.

About 10 genera and 75 species widely distributed over the entire world. Three genera are commonly represented in China, of these *Michelia* is chiefly confined to the south. *Michelia longifolia* Blume is the common Boh Lan of the gardens. *Michelia* is distinguished from *Magnolia* by the characters given in the key. It has no arborescent representative. Most authors include *Tetracentron* under *Magnoliaceae*. In *Tetracentron* the flowers are small and spicate, the flower parts in 4's and the wood, unlike nearly all the other Dicotyledonous woods, is without true vessels, in this respect identical with the wood of *Trochodendron*, the only other Chinese species known to have this characteristic; for these reasons it seems best to place *Tetracentron* under *Trochodendraceae*.

KEY TO GENERA

- A. Anthers introrse (facing inwards); mature carpels fleshy, dehiscent on the back; seeds fleshy, not winged; leaves entire or auriculate.
 - I. Flowers terminal; ovary sessile; ovules 1 or 2 in each carpel.
..... *Magnolia*.
 - II. Flowers axillary; ovary long stipitate; ovules 2 or more in each carpel..... (*Michelia*.)
- B. Anthers extrorse (facing outward); mature carpels dry, indehiscent; seed winged; leaves lobed or truncate..... *Liriodendron*.

LIRIODENDRON

Deciduous trees. Leaves alternate, long stalked, 2-6 lobed, nearly truncate or notched at the apex, never pointed. Enclosed in winter in flattened buds composed of a pair of stipules to each leaf; the twig encircled by a scar at each node. Flowers solitary with 3 sepals and 6 petals. Stamens numerous, surrounding the numerous pistils, imbricated in a cone-like axis. Anthers linear. Carpels 1 celled and 2 ovuled, becoming dry, indehiscent and winged, and as they mature, forming an erect cone-like fruit, the carpels gradually falling away from the central axis at maturity except a few outer, basal scales which are persistent for some time.

Only 2 closely allied species known, 1 North American the other Chinese. In preglacial times *Liriodendron* extended over the entire Eastern North America and over Europe as far south as Italy. The wood is light, soft and brittle, extensively used in America in the wood-working industries. The sapwood is creamy white, the heartwood greenish yellow. An alkaloid, which has the property of stimulating the heart, has been separated from the bark of the American species.

***Liriodendron chinense* Sargent.**

A small tree attaining a height of 16 m. Leaves 4 lobed, rounded or slightly heart-shaped at the base, shining green above, pale glaucous below, from 12-14 cm. long and as broad or broader. Petals 7-9 cm. long. Flowers 5-6 cm. long, cup-shaped greenish yellow, marked with orange inside at the base of the oblong-obovate petals. Cone-like fruit erect, light brown, slender, 9-10 cm. long, 2 cm. wide. Carpels bear 1-2 seeded nutlets at the base.

Kiangsi and Hupeh.

This tree is most desirable for street and lawn planting on account of its comparative freedom from insect pests and fungous diseases, as well as for its unique, 2-lobed leaves and large, handsome flowers.

MAGNOLIA

Deciduous or evergreen trees or shrubs. Leaves alternate, entire, stipules enveloping the leaves in the bud and leaving conspicuous encircling scars at each node. Flowers single, terminal, appearing before or with the leaves. Sepals 3, sometimes petal-like, deciduous; petals 6-18.



Plate 52. *LIRIODENDRON CHINENSE* Sargent

1. Fruiting branch ; 2. Flowering branch ; 3. Stamen ; 4. Scale of cone. (Details enlarged).

Stamens and pistils numerous, crowded on the receptacle, the stamens below the pistils. Carpels fleshy, 1 celled and 2 ovuled, 2 seeded. Fruit cone-like, composed of the scarlet or brownish carpels; the carpels dehiscent, opening on the back and exposing the seeds, which are usually scarlet and suspended by slender thread-like, stretching filaments. The outer portion of the seed is fleshy or pulpy, the inner hard and bony, flattened and more or less grooved.

Less than 30 species are recognized in America and Asia. Fossil remains clearly show that the genus once occupied a very extensive region. The magnolias are ornamental and showy shrubs and trees with large white, pink or purple flowers and handsome foliage. Several showy Chinese species with flowers appearing before the leaves in the early spring have been introduced into general cultivation in Europe and America. All parts of the plant have a bitter aromatic property. In China the powdered seeds of *Magnolia denudata* are used to allay inflammatory condition of the throat and eyes. A decoction of the flower buds is taken internally as a medicine.

Magnolia denudata Desrousseaux.

(*M. conspicua* Salisbury.)

(*M. yulan* Desfontaines.) Yulan.

Much-branched deciduous tree with rounded crown up to 16 m. high. Buds large, densely covered with stout, short pubescence. Leaves 7.6-17 cm. long, ovate or ovate-oblong, tapering to a short point, shining green above, downy below when young. Flowers in early spring well in advance of the leaves, large, 15 cm. across, white, fragrant. Petals and sepals alike, 9 in number, 10 cm. long.

In addition to the type with pure white lily-like flowers there are forms or variations with blossoms of a pink or rosy-red color. Also there are in cultivation in Europe and America numerous rosy or purplish flowered hybrids between this species and another (*M. liliflora*) from China which has deep purple flowers.

Magnolia delavayi Franchet.

Evergreen shrub or tree to 9 m. tall. Yunnan.



Plate 53. *MAGNOLIA DENUDATA* Desrousseaux

1. Flower ; 2. Sterile branch.

M. officinalis Rehder & Wilson.

Tree to 14 m. tall with yellowish branchlets and obovate leaves up to 45 cm. long. The fruit is oblong-ovate, 10–15 cm. long. Closely allied to the Japanese *M. hypoleuca* from which it may be distinguished by the yellowish and not purplish branchlets. The bark and flower buds are medicinal.

Hupei and Szechuan.

M. globosa var. **sinensis** Rehder & Wilson.

A shrub. Yunnan.

M. nicholsoniana Rehder & Wilson.

Shrubby or small tree 6 m. tall. W. Szechuan.

M. wilsonii Rehder.

Branchlets pubescent. Leaves densely silky tomentose beneath, 8–15 cm. long. Flowers cup-shaped, white, very fragrant; carpels and filaments red; fruit about 6 cm. long.

W. Szechuan.

M. aulacosperma Rehder & Wilson.

Tree 11 m. tall with the seeds grooved in the under surface.

W. Hupei.

M. dawsoniana Rehder & Wilson.

Tree to 10 m. tall. W. Szechuan.

M. liliflora Desrousseaux.

Large shrub with scentless flowers white on the inside and purplish outside. Common cultivated plant. China & Japan.

M. henryi Dunn. Yunnan.**M. coco** De Candolle.

Evergreen shrub with nodding white fragrant flowers.
Cultivated in S. China. Kwangtung.

M. biondii Pampinini. Shensi.

HAMAMELIDACEAE

Trees or shrubs. Leaves deciduous, alternate, simple, petiolate and stipulate. Flowers perfect, or unisexual, in compact spikes or heads. Sepals 4 or 5; calyx adherent to the ovary; petals 4-5 or absent; stamens 4-5, rarely 8. Ovary inserted in the bottom of the receptacle, 2 celled, 1 ovule in each cell, rarely more; styles 2, usually persistent. Fruit a woody capsule, opening in 2 valves at the summit, also often imperfectly dehiscent by an inner septum. Seeds usually 1 in each cell, if more, only the lower ones are fertile. Seeds winged or rarely wingless. Embryo surrounded by fleshy albumen.

About 20 genera with many species in the subtropic and warm temperate regions of both hemispheres. *Liquidambar* is the only arborescent genus in China.

LIQUIDAMBAR

Trees with resinous, fragrant sap and often corky branchlets. Leaves deciduous, alternate, simple, palmately 3-7 lobed, glandular serrate, long and slender petiolate, with small caducous stipules. Flowers monoecious, rarely perfect, apetalous. Staminate flowers without perianth, in racemose clusters; stamens indefinite, intermixed with small scales; filaments short and filiform. Pistillate flowers in a solitary, globular head on a slender peduncle, composed of confluent ovaries subtended by minute scales; stamens 4, rudimentary, inserted on the apex of the calyx; ovary partly inferior, 2 celled; ovules several or many; styles 2, incurved. Fruit a globose spiny head composed of the coherent capsules and their elongated styles. Capsule dehiscent at the apex between the base of the stigmas. Seeds 1 or 2, compressed, winged.

A genus of about 4 species in C. and W. Asia and N. and C. America.

Liquid storax, a gray-brown resin, is derived from *L. orientalis*, used in the Orient for medicine, perfumery and for the preparation of incense. The resin from the American species enters into the composition of chewing gum. The wood is straight grained, dark colored and handsome.

***Liquidambar formosana* Hance.**

(Fung Hsiang Shu.) Sweet gum.

Tree 20-40 m. tall, frequently with buttressed trunk. Leaves usually 3 lobed, cordate, rarely truncate; lobes broad at the base, tapering

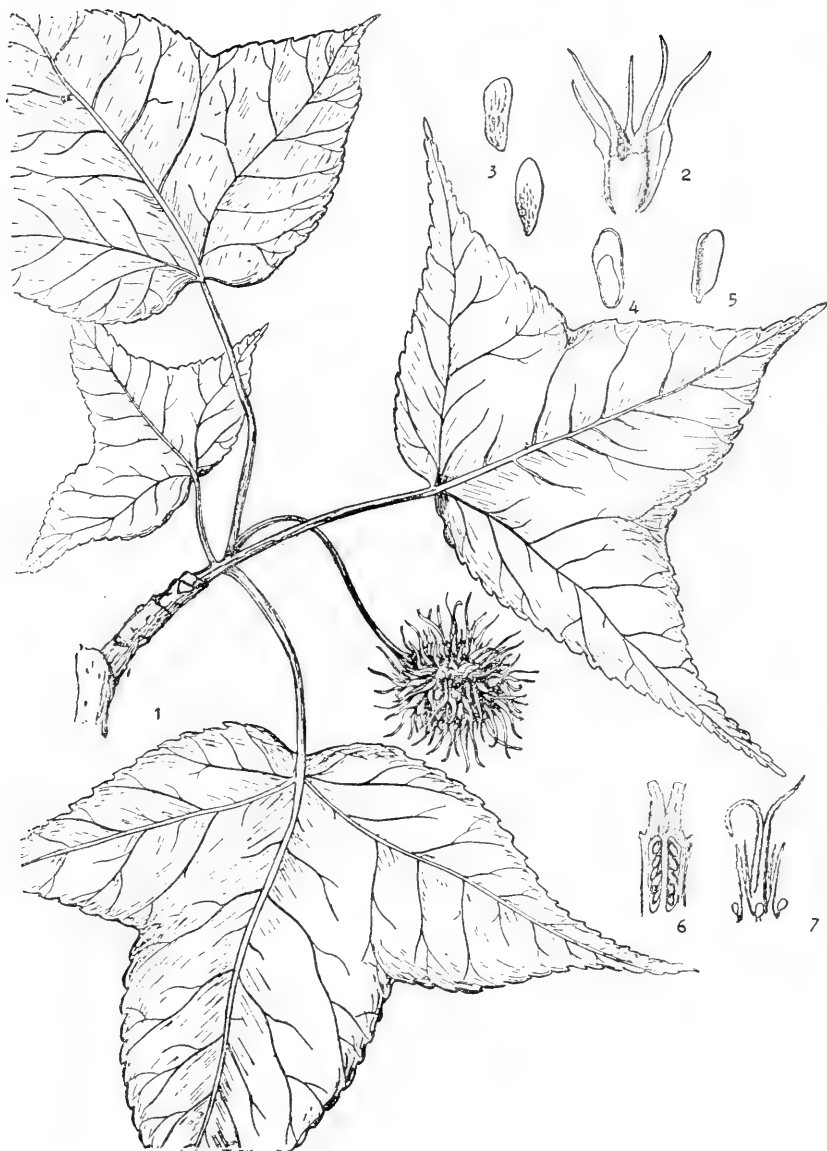


Plate 54. *LIQUIDAMBAR FORMOSANA* Hance

1. Fruiting branch; 2. Mature fruit; 3. Seeds; 4. Section of fruit;
 5. Embryo; 6. Section of ovary; 7. Style and staminodes.
 (Details adapted from Hooker's "Icones Plantarum.")

to a long, narrow point; serrate, pubescent beneath when young, glabrous on older trees, dull green. Fruit globose, spiny, due to the long awned scales surrounding the ovaries, becoming hard and woody at maturity.

The juvenile leaves and petioles of this species densely villose. Leaves with 5 narrow lobes.

S. E. to W. Central China.

A widely distributed tree with a range extending from Formosa and Kwangtung to Thibet. The tree prefers a moist situation. The foliage turns brilliantly brown and red in the autumn and is retained late into the winter. The wood is said to be used in China for making tea chests and the presses in which brick tea is molded, but the wood is usually considered of little value. Some farmers soak the wood for a length of time in a pond or stream, a practice which is supposed to improve the quality of the timber. In Kwangtung a silkworm which produces a strong, coarse silk-gut is fed on the leaves.

var. monticola Rehder & Wilson.

A form distinctly glabrous on both the young and the mature plant.

EUCOMMIACEAE

Tree with alternate leaves without stipules. Flowers without perianth, unisexual. Staminate flower pedicelled with 8-10 short stamens; pistillate flower short stalked, solitary; carpels 2, one of which aborts, long pedicelled; ovules 2, suspended. Winged fruits narrowed towards the base.

A family of a single species. Confined to China.

EUCOMMIA

Trees with laminate pith. Leaves deciduous, alternate, simple, serrate, elliptic-ovate, acuminate, short petioled, glabrous above, pilose on the veins beneath. Flowers appear before the leaves, dioecious, without perianth, solitary on the axil of a bract. Staminate flowers composed of 8 (6-10) stamens on a short pedicel, subtended by a bract; stamens with elongated, linear anthers produced at the apex into a short point, on a short filament. Pistillate flower composed of a naked,

elongated ovary with 2 stigmatic lobes at the apex, on the axil of a bract; ovary 1 celled, 2 ovuled. Fruit an ovate-oblong samara; the wing coriaceous, surrounding the nutlet, notched at the apex, tapering at the base. Nutlet compressed, 1 seeded.

West China.

So far unreported in a wild state, known only in cultivation. A monotypic genus variously assigned to *Trochodendraceae*, *Magnoliaceae* and *Hamamelidaceae* according to different authorities, but now segregated as a distinct family closely allied to *Hamamelidaceae*. *Eucommia* is remarkable on account of the presence of numerous elastic threads which yield a good grade of rubber, in all parts of the plant except the wood. The presence of rubber may be detected by breaking a piece of the inner bark, a leaf or a fruit in two, and pulling the portions apart, the elastic fibres appear as fine threads of a silky sheen. Unfortunately the rubber content is low, in the bark only 3% of its dry weight, and the extraction difficult, so that commercial exploitation of this tree is impracticable. The bark, however, is extensively employed as medicine, valued for its fancied or real tonic properties. The bark is stripped from the tree, ultimately causing its death. Propagated by cuttings or by seeds. Germination is uncertain.

***Eucommia ulmoides* Oliver.**

(Tuchung Shu.)

Trees up to 18 m. tall, more often smaller. Leaves 8-18 cm. long, ovate-elliptic, serrate, acuminate, cuneate at base, dark shining green above, pubescent when young below. Petiole 12-20 mm. long. Fruit 3-4 cm. long, 6-12 mm. wide, oblong, notched at the apex.

Western Hupeh, Szechuan.

LAURACEAE

Aromatic or sometimes foetid trees, shrubs, rarely under-shrubs, or very rarely leafless parasites (*Cassythia*). Leaves alternate, without stipules (exstipulate), sometimes whorled or crowded close together, rarely opposite, simple, entire, rarely lobed (as in *Sassafras*), palmately veined or penninerved, punctate with glands containing a volatile oil and often pellucid.

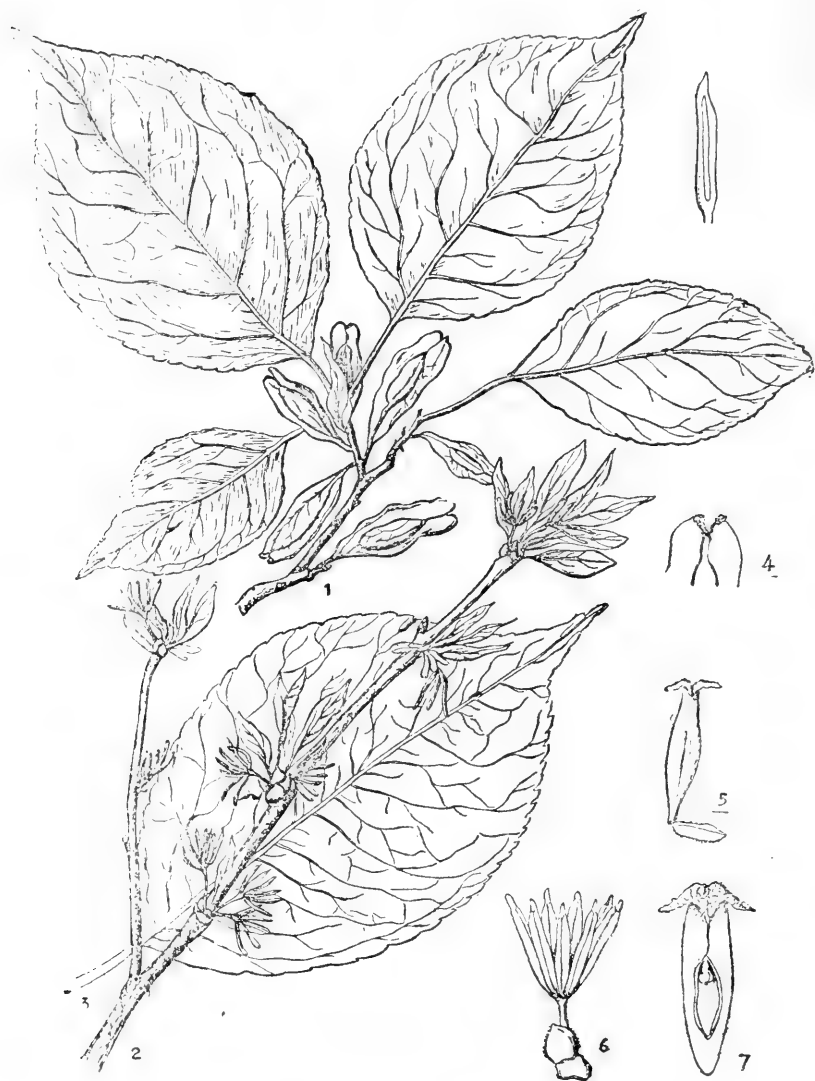


Plate 55. *EUCOMMIA ULMOIDES* Oliver

1. Fruiting branch ; 2. Flowering branch ; 3. Leaf ; 4. End of seed ;
 5. Pistillate flower ; 6. Staminate flower ; 7. Section of ovary.
 (Details adapted from "Icones Plantarum.")

Flowers usually axillary, small, white, yellowish or greenish, perfect or unisexual, sometimes dioecious or polygamo-dioecious. Perianth regular, simple, without petals (apetalous), gamosepalous (the sepals more or less united), forming a short tube with 6-9 lobes (rarely 4). In some genera the lobes are deciduous, in others persisting and adhering to the base of the fruit. Stamens as many as and inserted on the perianth lobes, (perigynous) or a multiple of them; alternately fertile and sterile (staminodes) and with or without glands at the base. Anthers 2 or 4 celled, opening by trap-door-like valves from below. Ovary 1-celled, 1-ovuled (rarely 2 ovules), the ovules pendulous, anatropous. Fruit usually a berry, rarely a drupe or dry, globose or ellipsoid in form, usually on a thickened pedicel or narrowed at the base by the more or less thickened calyx-tube. Seed solitary, without albumen (exalbuminous) and with straight embryo and superior radicle.

This family includes about 40 genera and nearly 1,000 described species of trees and shrubs. They are most widely distributed in warm or tropical regions, comparatively few being found in temperate climates. The type of the genus is *Laurus nobilis*, the Royal Bay-tree, of the Mediterranean region.

The aromatic character of most species makes them particularly valuable as furnishers of spices and stimulants. A few are regarded as poisonous.

Among the better known products of the family are Camphor, Cinnamon, Cassia buds, and the Avocado or Alligator Pear (*Persea gratissima*). The wood of many species is beautiful, enduring and easily worked, and is in much demand for furniture and cabinet making.

In China the finest woods are produced from the "Changshu" or camphor trees and from species of *Lindera*, *Machilus* and *Phoebe* which are commonly known as "Nanmu" in various forms.

KEY TO GENERA

I. Leaves deciduous, entire or 1-3 lobed.

A. Flowers in long-stalked umbels; anthers 4 celled. *Sassafras*.

B. Flowers in short-stalked clusters or umbels; anthers 2-celled
 *Lindera*.

II. Leaves persistent, entire.

- A. Flowers crowded in umbel-like cymes, each cyme subtended by 4 concave bracts; drupe on a thickened perianth tube.
..... *Litsea*.
- B. Flowers separate in loose panicles.
 - 1. Leaves mostly 3-nerved; perianth lobes deciduous; fruit on an enlarged pedicel..... *Cinnamomum*.
 - 2. Leaves mostly pinnately veined; perianth lobes persistent under the fruit; pedicel not enlarged.
 - a. Anthers all extrorse..... *Phoebe*.
 - b. Anthers some extrorse and some introrse.. *Machilus*.

SASSAFRAS

Trees, deciduous. Leaves alternate, somewhat crowded towards ends of branchlets, entire or 2 or 3-lobed (very rarely 5-lobed), with slender petioles.

Flowers in axillary long-stalked umbels near the ends of the branchlets, imperfect, usually dioecious. Stamens 9, inserted in 3 series on the margin of the thickened or fleshy calyx tube, the innermost series each with 2 orange-colored glands at the base; anthers 4-celled, introrse.

Fruit a dark blue drupe inserted on a thickened receptacle formed by the calyx tube; the receptacle reddish colored.

Only 3 species are known, 1 in Eastern North America, 1 in China and 1 in Formosa. The Chinese species is scarcely distinguishable from the American one.

The leaves of the sassafras are aromatic and are either entire or 1-3 lobed with broad sinuses, at first bright green in color, later changing to brilliant shades of yellow and red in the autumn. The fruits are brightly colored, augmenting the ornamental character of the foliage.

The tree has a long tap root and cannot be readily transplanted. Sassafras produces many suckers, by which means the tree is sometimes propagated.

Sassafras tzumu Hemsley.

(Pseudosassafras tzumu Lecomte.)

Tree to 35 m. tall, sometimes a meter or more in diameter, of pyramidal habit with stout, straight trunk and rugged horizontal branches. The bark on young trees smooth and grayish-green, on mature trees dark gray-brown, irregularly furrowed. Leaves ovate or obovate, entire or 1 to 3 lobed at the apex, pinnately veined, silky pubescent when young, later glabrous, 10-20 cm. long, on slender petioles. Flowers profuse, yellow, opening in early spring with the unfolding of the leaves, in racemes, perfect, about 5 mm. across, pubescent on the inner surface; staminodes 3, alternating with the 3 glandular stamens. Fruit about 12 mm. high, bluish black, covered with a glaucous bloom, embraced at the base by an orange-red cup formed by the thickened calyx tube.

The wood is aromatic, dull yellowish-brown in color, soft, brittle, weak and coarse but durable in contact with the ground. From the bark of the roots of the American *Sassafras variifolium* Kuntze, which is very similar to the Chinese species, oil of sassafras, used in perfumery, is extracted. The essential oil is also employed as a mild stimulant. Experiments on the extraction of the oil from the Chinese sassafras should be interesting and might prove profitable.

Hupei, Kiangsi and Chekiang.

CINNAMOMUM

Trees or shrubs, evergreen. Bark and twigs very aromatic. Leaves alternate or opposite, sometimes crowded towards the end of the branchlets, coriaceous, entire, in most species with 3 main nerves or veins.

Flowers small, in large axillary panicles, often appearing terminal, from the axils of uppermost leaves, dioecious or polygamous. Stamens 9, each of the 3 inner ones having 2 glands at the base; anthers 4 celled, extrorse; staminodes 3. Fruit small, ovoid on a more or less enlarged perianth.

About 130 species have been described. Native to eastern Asia, Australia and the Pacific Islands. The genus *Cinnamomum* includes several important economic trees, among them *C. zeylanicum*, from China and India, from which the cinnamon spice of commerce is obtained; *C. cassia*, which yields the cassia bark used in medicine; and *C. camphora*, widely cultivated in tropical and sub-tropical countries.



Plate 56. *SASSAFRAS TZUMU* Hemsley

1. Fruiting branch ; 2. Section of Staminate flower ; 3. Perfect flower, perianth removed ; 4, 5. Stamens ; 6, 7. Floral diagram (from Engler and Prantle). 8. Ovary ; 9. Seed. (Details enlarged.)

Cinnamomum camphora (L) Nees and Ebermaier.

(*Laurus camphora* Linnæus.)

(*Camphora officinarum* Nees.)

True Camphor or "Chang shu."

An evergreen tree occasionally attaining 30 m. in height and 2-2.5 m. in diameter of trunk, usually much smaller. The bark of the trunk is smooth and green, that of young branches is glabrous and shining. Buds scaly.

Leaves alternate, on slender pliant petioles about 2.5 cm. in length. Leaves thick, stiff, bright green, smooth and polished above, pale green or with a conspicuous glaucous bloom beneath, pinkish when unfolding, the margin entire. They are generally oval, 8-15 cm. long, acuminate, tapering to both ends or sometimes abruptly acuminate at the apex or rounded or heart shaped at the base, appearing trinerved because of the size and prominence of the two lowest lateral nerves or veins which curve and run some distance nearly parallel to the edges. In the axils of these and other principal veins are distinct punctate glands which are visible on both surfaces.

Flowers perfect, greenish-white or yellowish, very small, on slender branching pedicels, forming small, spreading cymes of 2 or 3 arranged in small, erect, long-stalked, axillary panicles shorter than the leaves. Perianth with a short, thick, fleshy tube and 6 imbricate, nearly equal, blunt and thick, horizontally spreading segments, smooth externally, densely hairy on the inside, becoming deciduous and falling from the tube. Stamens 9; staminodes usually 6; stamens erect, shorter than the perianth segments and the 6 outer stamens opposite the 3 outer perianth segments, extrorse and provided at the base with a large, stalked, thick, obcordate gland on either side. Filament hairy. Anthers large, oblong, 4-celled, with valvular dehiscence. Staminodes in 2 rows of 3 each, stalked, oblong or sagittate, the outer 3 having 2 glands at the base of each, resembling those of the inner stamens. Ovary free from, but surrounded by, the perianth tube; 1-celled and 1-ovuled. Style slender, as long as the stamens, stigma small. Fruit a drupe, ovoid or globular, about 6 mm. in diameter or the size of a large pea, smooth, purplish or black (some writers have described it as red), surrounded at the base by the



Plate 57. CINNAMOMUM CAMPHORA Nees

1. Flowering branch ; 2. Fruiting branch.

enlarged persistent perianth tube; flesh thin; seed large, solitary, smooth, exalbuminous; cotyledons large, plano-convex, fleshy or oily; embryo straight.

Varying with latitude and altitude the flowers appear from April to June and the fruit matures from September to November.

The true camphor tree is native in China, Japan, Korea and Formosa. It is now cultivated in many of the tropical and warm temperate regions of the world. The tree usually does not attain great size, or over 1 m. in diameter of trunk. Old, broad-buttressed specimens, of great age, are sometimes found about temples and shrines in China and Japan, these are reported as measuring 6-8 m. in diameter of trunk or buttress at 1.5 m. from the ground.

China: Kiangsi, Fukien and Kwangtung, rare in Hupeh and Szechuan.

Both wood and leaves contain the camphor, a concrete volatile colorless oil, lighter than water, with a penetrating odor and pungent but cooling taste. It is very soluble in fixed and volatile oils, in alcohol and ether, evaporating completely in the air, and is very inflammable. Dissolved in alcohol, oil and vinegar, it is much employed externally for rheumatism and contusions. Taken in overdoses it may produce insensibility and even death.

The branches and wood are the parts generally utilized. The amount of camphor varies in the different parts of the tree, the branches containing the least, about 2%; the roots the most, usually 6 or 7%. The camphor is obtained by cutting the wood into small chips and submitting these to a process of sublimation through steam. The process of production varies in different regions. The greater part of the world's supply of pure camphor is produced in Formosa. A common process of production in use there is as follows:—

A long wooden trough, with a coating of clay to protect it from fire, is fixed over a furnace. Water is then poured into it and over it a board perforated with numerous small holes is fitted. The wood of the camphor-tree is cut into small chips and these are placed above the holes and covered with earthen pots. Then a fire is lighted in the furnace, the water becomes heated and as the steam rises it passes through the holes and the chips, carrying with it the camphor vapor which condenses in the upper part of the pots, and from which the camphor is scraped out every few days.

Various allied species of *Cinnamomum* contain camphor but they are not generally recognized as of equal economic importance with *C. camphora*.

Camphor or a close imitation of it is also produced from other plants belonging to other families, as from a species of *Dryobalanus* and from a species of *Blumea*, natives of tropical Asia outside of China.

Cinnamomum camphora as well as other species of the genus is usually propagated by seeds which are sown as soon as ripe in shaded beds. As transplanting is extremely difficult and rarely attended with success, either one of the two following methods is usually followed in establishing plantations.

The first method is to sow the seeds directly in the forest. Four or five seeds are usually put in each hole, under the shelter of the standing trees, which afford the requisite shade for the growth of the seedlings. For the first few years some care must be given them, that is, they should be thinned when necessary, and kept free from weeds until they are well established. The pot-grown method, however, seems preferable. The seeds are sown in prepared beds and when very young the seedlings are transplanted into pots, where they are allowed to remain until they are ready to be set out into the permanent plantation. This should be the method employed for establishing a new plantation. Camphor trees may also be grown from cuttings of half-ripened wood, rooted in the spring in moderate heat. This species prefers a well drained, sandy loam.

The wood of *Cinnamomum camphora* is very valuable. It is light brownish in color, beautifully grained, and taking a high polish. It has a characteristic taste and odor, extensively used for interior finish, furniture, chests and for cabinets on account of its repellent effect on insects, and formerly it was much used for boat building.

***Cinnamomum cassia* Blume.**

Handsome tree. Leaves oblong-lanceolate, stiff, glossy green, pubescent on the lower surface, 8-16 cm. long. Inflorescence axillary, paniculate, pubescent, 8-16 cm. long; flowers small. Drupe the size of a pea.

China and Sumatra. Cultivated in warm countries for the cassia bark.

***Cinnamomum zeylanicum* Nees.**

Cinnamon Tree.

Small tree to 10 m. tall. Buds silky pubescent. Leaves coriaceous, shiny, ovate to ovate-lanceolate, apex acuminate, base acute, 3-5 nerved, reticulate and glabrous beneath, 8-18 cm. long. Inflorescence in silky pubescent panicles, as long as the leaves, mostly clustered in the axils of the upper leaves; flowers numerous, small, about 6 mm. high, yellowish, with grayish hairs on the outside. Fruit 10-16 mm. long, dry or slightly fleshy, pointed, surrounded by the enlarged perianth.

Cultivated in Kwangtung. The planting of this tree might be extended into a profitable industry.

PHOEBE

Evergreen trees or shrubs, leaves alternate, scattered, often irregularly grouped toward the end of the yearly growth, entire, pinnately veined. Flowers small, perfect or polygamous, in axillary and subterminal panicles or corymbs. Perianth tube short, the segments 6, subcoriaceous, about equal in size, erect and enlarging and ultimately clasping the base of the fruit. Fertile stamens 9, in 3 series, the 1st and 2nd series without glands and with introrse 4-celled anthers, the 3rd series with 2 glands subtending each stamen and with extrorse 4-celled anthers. There is an inner or 4th series of 3 small stipitate or stalked staminodes with cordate or sagittate apex.

Fruit a fleshy berry usually ellipsoid or oblong, inserted upon or clasped at the base by the persisting 6-parted cup or perianth, and containing a single large, smooth seed.

Perhaps 25 or 30 species of *Phoebe* have been described. They are chiefly East Indian and Malayan.

There is a very close relationship between this genus and *Machilus* and *Persea*. The species of *Machilus* and *Phoebe* in western China are all evergreen and handsome trees. According to Wilson, in Szechuen they are abundant up to an altitude of 1,000 metres, often forming extensive forests. Some of them grow to great size and have broad, dense heads. The wood is close grained, fragrant, greenish white and brown in color, easily worked and very durable. It is much valued in furniture making and the construction of temples and houses. It is also used for the bottoms of boats.

Phoebe nanmu (Oliver) Gamble. (1914).*(*Persea nanmu* Oliver). (1880).(*Machilus nanmu* (Oliver) Hemsley). (1891).

A tree sometimes 30 m. high and 1.5 m. in diameter of trunk; branchlets slender, more or less hirsute or pubescent when young, at length becoming glabrescent. Leaves coriaceous, broadly lanceolate, or somewhat obovate, usually from 5 to 10 cm. in length and from less than 1.2-4 cm. wide in widest part, abruptly acuminate at apex, the base narrowly or broadly cuneate, glabrous above and distinctly gray or brown pubescent on the lower surface, especially along the midrib and principal veins.

Flowers with 6 perianth segments, short and rounded at the apex and united at the base into a broad spreading cup which serves as a receptacle for the fleshy fruit.

Fruit an ovoid, fleshy, blackish berry, about 12 mm. long on short pubescent pedicels which enlarge but slightly at the base of the perianth cup. Ripe in September and October.

Found in Yunnan and Western Szechuan where it has been described as a common tree attaining large size.

There are several other species of *Phoebe* which have been described as native in China and there are some as yet not described or named.

Phoebe neurantha (Hemsley) Gamble.(*Machilus neurantha* Hemsley).

Recorded from Kiangsi, Hupeh and Szechuan.

Phoebe sheareri (Hemsley) Gamble.(*Machilus sheareri* Hemsley).

Kiangsi, Chekiang, Hupeh and Szechuan.

Phoebe macrophylla (Hemsley) Gamble.(*Machilus macrophylla* Hemsley).

A native of Hupeh and Szechuan.

This species must be given a new botanical name because there already existed a *Phoebe macrophylla*, described by Blume and published

*NOTE—The synonymy given above indicates the close relationship of the three genera. It is sometimes impossible to assign a species to its proper genus without adequate specimens for study.



Plate 53. *PHOEBE NANMU* Gamble

1. Fructing branch ; 2. Flowering branch ; 3. Section of ovary ; 4. Section of flower ; 5. Stamen. (Details enlarged).

in "Museum Botanicum Lugdano-Batavum" in 1851, a distinct species, and a native of Java, whereas Gamble's use of the name for this Chinese species was not established until 1914 (see "Plantæ Wilsonianæ," vol. II, p. 71, 1914). As, therefore, a new name must be given to this species it is here proposed to name it *Phoebe chinensis* Chun. A description of the species follows:—

***Phoebe chinensis* Chun.**

(*Phoebe macrophylla* Gamble.)

(*Machilus macrophylla* Hemsley.)

Tree up to 10 m. tall. Branchlets rounded, glabrous or glabrescent, dark gray. Leaves evergreen, sparsely scattered on the branches, thick, leathery, narrowly lanceolate to oblong-lanceolate, acuminate at the apex, narrowed toward the base, green on both surfaces or slightly paler beneath with somewhat inconspicuous primary veins and finely reticulated ultimate veins, about 22 cm. long; petioles 2-4 cm. long, slender. Flowers yellow-green in narrow, erect, terminal cymose panicles; perianth greenish-yellow, valvate, in 2 unequal series (the inner one larger); perianth segments ovate-oblong, thick, with ciliate margins, somewhat sparsely hirsute on the inner surface. Filaments furnished with minute hairs at the base. Ovary entirely glabrous. Drupe globose, with the thickened perianth segment appressed beneath.

Hupeh and Szechuan.

This handsome evergreen tree is one of the most useful and abundant of Nanmus. The wood, which is olive-green and brown, is fragrant and durable. It is a favorite tree for ornamental planting in the provinces of the West.

MACHILUS

Aromatic, evergreen trees with alternate, entire, pinnately veined leaves. Flowers perfect or polygamous, in terminal panicles. Perianth 6 cleft, the outer segments usually equal to, or slightly smaller than, the inner ones, the segments usually persisting entire around or under the berry. Stamens 9; anthers 4-celled; 6 of the anthers opposite the perianth segments open outwards (extrorse) bearing a short stalked gland at each side of the base of the filament. Pedicels not enlarging or thickening under the fruit or berry. The panicles sometimes become lateral by

elongation of new shoots. Fruit a globular or nearly globular fleshy berry, usually less than 1.2 cm. in diameter, occasionally up to 2.5 cm. in diameter.

This genus much resembles *Cinnamomum* and differs chiefly in having the perianth segments persisting with the berry and in the end of the pedicel beneath it not being dilated or thickened.

About 15 species known, all natives of tropical or subtropical Asia and Malay Archipelago, the species most abundant in India.

***Machilus ichangensis* Rehder and Wilson.**

Tree to 15 m. tall, usually smaller. Branches slender, dull red, rarely dark gray, with few lenticels, glabrous. Leaves alternate, papery, oblong-lanceolate, or lanceolate, long acuminate, gradually narrowed toward the base, rarely broadly cuneate, glabrous, bright yellow-green above, glaucescent, glabrous or rarely slightly silky pubescent beneath, finally glabrous, with 12-17 pairs of lateral veins, the ultimate veins reticulated; petiole slender, channelled above, about 1.5 cm. long, rarely longer. Panicles from the axils of caducous bracts on slender peduncles, 3.5-5 cm. long; flowers white, the perianth almost divided to the base, the segments 5-6 mm. long, silky pubescent outside, glabrous, except toward the tips on the inside; stamens 9, shorter than the perianth lobes, unequal in length; anthers oblong-obtuse; ovary subglobose, glabrous; style enlarged at the base. Drupe subglobose, minutely pointed at the apex, 6-7 mm. across, glabrous and shiny black, subtended at the base by the persistent, thickened perianth lobes; pedicel scarcely thickened.

This tree is locally known as Hsiao Nanmu or Little Nanmu. It was formerly confused with *Machilus thunbergii* Siebold and Zuccarini of Japan, but now considered distinct from that species.

Fukien, Hupeh, Kwangtung.

***Machilus bournei* Hemsley.**

A tall, densely leafy tree from 15-30 m. in height and 1-1.5 m. in diameter. Mature leaves coriaceous, oblong-lanceolate, long acuminate, tapering to a cuneate base; usually from 5-10 cm. long and from 1.2-4 cm. wide. Young shoots and leaves distinctly tomentose or puberulent

when young, leaves becoming glabrous and bright shining green on the upper surface as they mature, pale and puberulent below.

The flowers are small and in color are white to creamy white or yellowish, the flower buds, perianth and pedicels being decidedly pubescent, with short gray or brown hairs.

Fruit undescribed.

Common as a forest tree in Hupeh and Szechuan. It is particularly abundant on the Chengtu plain and is much planted about temple grounds and homes.

Among other species reported from China are:

Machilus velutina Champion, from Fukien and Kwangtung.

Machilus chinensis Hemsl., from Kwangtung.

There are other species which have been named and no doubt some as yet not named in our Chinese forest flora.

LITSEA

Evergreen or rarely deciduous trees or shrubs. Leaves alternate, rarely opposite, mostly pinnately veined (in some species 3-nerved). Flowers dioecious, small, white or yellow, crowded in axillary, umbel-like cymes, subtended by concave, imbricate bracts which look like sepals; perianth tube ovoid or campanulate or very short, segments 6-4 (more or fewer), equal or unequal or rarely absent; stamens and staminodes usually 6-2, the filaments of the 2 outer sets usually without glands; anthers usually all introrse, 4 celled. Fruit a dry or fleshy drupe seated on the enlarged perianth tube, frequently in umbellate clusters.

About 150 species, mostly in the tropics; about 15 species have been described from China. A genus of no commercial importance.

***Litsea sericea* (Wallich) Hooker.**

Small aromatic tree to 6 m. tall. Branchlets, under surface of the leaves and peduncles with long, silky hairs. Buds scaly. Leaves alternate, deciduous, pinnately veined, oblong-lanceolate, acute at the base, 8-10 cm. long. Flowers appear before the leaves, in solitary, short

peduncled umbels, provided with four glabrous, caducous bracts, sepals 6, obtuse; stamens 12; ovary ovoid with stout style or a large stigma. Fruit sub-globose, about 6 mm. long; perianth tube small, flat; peduncle 2-5 cm. long.

Himalaya to Hupeh and Szechuan.

***Litsea citrata* Blume.**

Shrub or small tree. Nearly glabrous. Buds naked. Leaves membranous, lanceolate, green above, glaucous below, 10-11 cm. long. Flowers with the leaves in solitary or clustered umbels; stamens 9-10 cm. long. Fruits black, 4-6 mm. long.

India to Szechuan, Hupeh and Kiangsi. In India a silkworm is raised on the leaves of this plant.

Litsea faberi Hemsley is another arborescent species. It extends from India to S. and W. China.

LINDERA

Trees or shrubs usually deciduous. Leaves entire or sometimes 3-lobed (resembling *Sassafras*).

Flowers yellow, in nearly sessile or in short-stalked axillary clusters or umbels, dioecious or polygamous, apetalous; the male flowers with 9 stamens in 3 rows or series, those of the inner series bearing glands at the base; anthers 2 celled and 2 valved. Pistillate flowers often show numerous rudiments of stamens, ovary globose.

Fruit a fleshy drupe, black or red in color.

A genus with numerous species in Asia and few in North America. The aromatic oil of some species is used in perfumery. (Benzoin is a synonym of the genus.)

The only common arborescent species is:—

***Lindera megaphylla* Hemsley.**

Tree to 20 m. tall with rough gray bark. Fruit plum-like. The wood is valuable.

W. China.



Plate 59. *LINDERA MEGAPHYLLA* Hemsley

1. Fruiting branch ; 2. Flower ; 3. Stamen ; 4. Pistil ; 5. Flowering branch (from *Botanical Magazine*.)

ROSACEAE

Leaves usually alternate, dentate, lobed or divided, usually with stipules. Flowers generally regular. Stamens distinct, indefinite. Carpels one to many, distinct or united with the calyx tube. Ovules usually 2 in each cell. Seeds exalbuminous.

A family consisting of 90 genera and about 1,500 species, most abundant in the temperate region, but widely distributed throughout the world. Many genera are cultivated for ornament and for their edible fruits.

In a work of limited scope only the more important arborescent genera can be dealt with.

KEY TO GENERA

A. Fruit a pome inclosing bony or papery carpels.

I. Carpels bony at maturity, flowers in cymose-corymbs; ovary 1-5 celled; ovules 1 in each cell or if 2, 1 sessile and fertile, the other stalked and sterile; deciduous, usually thorny shrubs or trees; fruit with 1-5 bony seeds.....*Crataegus*.

II. Carpels with leathery or papery walls at maturity.

a. Carpels as many as the styles.

(a) Carpels partly free.

1. Flowers in simple cymes on short lateral spurs; ovary 3-5 celled, styles more or less connate below; winter buds small.....*Malus*.

2. Flowers in compound cymes; ovary usually 3 (2-4) celled; style distinct; leaves mostly pinately compound; winter buds large.....*Sorbus*.

(b) Carpels wholly connate; styles 5, distinct; fruit large, pear shaped, yellow; evergreen tree.....*Eriobotrya*.

b. Cells of the ovary twice as many as the styles, flowers in racemes; ovary inferior or partly so; styles 2-5; more or less connate below; fruit subglobose; leaves simple deciduous.....*Amelanchier*.

B. Fruit a 1-seeded drupe; ovary superior, not inclosed in calyx tube at maturity, 1 celled; style terminal; leaves simple, deciduous...*Prunus*.

PRUNUS

Trees or shrubs. Leaves deciduous or persistent, alternate, simple, usually serrate, petiolate; petioles often glandular. Flowers in umbels, racemes, corymbs or solitary, perfect. Calyx tubular, 5 lobed, often colored; petals 5, white or pink, deciduous; stamens numerous (usually 15-20), perigynous, inserted on the calyx tube with the petals; ovary 1 celled, terminated by a single style; ovules 2. Fruit a 1-seeded drupe, fleshy or coriaceous; stone bony, round or compressed, indehiscent, 1-seeded by abortion.

About 120 species mostly in the temperate regions of N. America, Asia and Europe. Under the genus, plums, almonds, peaches, apricots, and cherries are now included. They are extensively cultivated for their fruits, which form an important food for man. The bark and leaves of several species have medicinal properties. A few are arborescent, yielding a hard, close grained, durable wood, generally brown in color, more or less tinged with red, used for interior finish, furniture and musical instruments. Many members of the genus have a high ornamental value and are cultivated sometimes exclusively for their bloom.

The species of *Prunus* are too many to describe in this work. The divisions of the genus are:

- Subgenus I. *Prunaphora*, plums, prunes and apricots.
- „ II. *Amygdalus* includes almonds and peaches.
- „ III. *Cerasus* includes the common cherries.
- „ IV. *Padus* includes those cherries usually known as bird-cherries in which the flowers are produced in long racemes.

***Prunus padus* Linnaeus.**

Bird Cherry.

A shrub or small tree, 10 m. tall. Bark speckled and rough. Branchlets glabrous. Leaves conduplicate in the bud, about 10 cm. long, elliptic to oblong-ovate to obovate-oblong, acuminate, glabrous, sharply and finely serrate; petiole glabrous and glandular at the apex. Leaves unfolding very early in spring. Flowers in long drooping racemes, white, on slender peduncles; calyx glabrous; sepals twice as long as the stamens. Fruit globose, black, lustrous, about 8 mm. in diameter. Stone rough.

Very widely distributed throughout Europe, Caucasus, Siberia, China, and Japan. The bark and leaves which are unpleasantly odorous when bruised, contain an astringent, bitter property used in medicine.



Plate 60. PRUNUS PADUS Linnæus

1. Flowering branch; 2. Fruiting branch.

***Prunus persica* Stokes.**

Shrub or small tree. Leaves oblong-lanceolate, serrate, conduplicate in the bud, with a short glandular petiole. Flowers appearing before the leaves, solitary, pink, sepals more or less pubescent on the inner surface. Fruit a drupe, soft and fleshy when ripe, pubescent. Stone hard and deeply pitted.

Native of China, widely cultivated. This is the parent of the common peach.

***Prunus mira* Kohn.**

Tree 10 m. tall. This species differs from all other known peaches by the smooth stone.

Szechuan.

The fruits are edible.

***Prunus triflora* Roxburgh.**

This cherry is both wild and cultivated in W. China. It has been introduced into cultivation in Korea, Japan, Europe, and N. America.

***Prunus mume* Siebold and Zuccarini.**

Plum Tree.

Numerous horticultural varieties have been developed. The species is too well known to need a description.

AMELANCHIER

Trees or shrubs. Leaves deciduous, alternate, simple, entire or serrate, pinnately veined, petiolate, with linear, rose colored, caducous stipules. Flowers perfect, in racemes, rarely solitary on slender pedicels furnished with 2 deciduous bracts. Calyx tube campanulate or urn-shaped, with 5 persistent lobes; petals white, obovate-oblong, spatulate or ligulate, contracted below; stamens usually 10, filaments persistent on the fruit; styles 2-5; ovary more or less adnate to the calyx tube, 5 celled with 2 ovules in each cell. Fruit a berry-like pome with a cavity at the summit and sweet, juicy flesh. Seeds 10 or rarely 5 by abortion, ovate-elliptical.

N. America, S. Europe, N. Africa, S. W. Asia.



Plate 61. PRUNUS PERSICA Stokes

1. Fruiting branch; 2. Flowering branch; 3. Pit.

Central China, Japan. About 20 or 25 species have been enumerated. 2 species so far have been described from China. Only a few of the genus are arborescent. Nearly all species have a sweet, pulpy, edible fruit. *Amelanchier* is also cultivated for its flowers, which bloom in early spring.

***Amelanchier sinica* (Schneider) Chun**

(*A. asiatica* var. *sinica* Schneider.) Shad Bush.

Small tree, rarely 15 m. tall. Leaves ovate to oblong, acute, rounded at the base, often entire or distinctly serrate only on the upper half of the margin, loosely and sparingly tomentose beneath when young, usually finally glabrous, about 4.5 cm. long, 2.8 cm. wide. Flowers in dense racemes; style as long as the calyx lobes and more or less united below, ovary glabrous. Fruit bluish-black.

Western China.

Distinguished from *Amelanchier asiatica*—which does not occur in China—by the smaller, less tomentose leaves, entire or serrate only on the upper 1/3 of the margin and also by the glabrous ovaries. E. H. Wilson notes that this is the commonest and most beautiful small tree in the woods of W. Hupeh. The bluish-black fruits are edible.

ERIOBOTRYA

Evergreen trees or shrubs. Leaves alternate, coarsely toothed, short stalked or almost sessile. Flowers in terminal panicles. Calyx tube 5 toothed, woolly; corolla of 5 petals; stamens 20-40; styles 2-5, united below; ovary inferior, 2-5 celled, cell 2-ovuled. Fruit a pome with thin endocarp surrounding the large angular seeds.

About 10 species in the warmer parts of China, Japan and the Himalayas.

***Eriobotrya japonica* Lindley.**

“Pe Peh.”

An evergreen tree up to 10 m. high. Young branches thick and woolly. Leaves large, 15-30 cm. long, acuminate, tapering or wedge shaped at the base, shining green above, brownish woolly below, with parallel veins terminating in the teeth. Flowers 12-20 mm. across, white, hawthorn-like, fragrant, borne in upright panicles. Fruit roundish, pear-shaped or oval, with persistent calyx tubes and thin yellow flesh, surrounding the large, dark brown seeds.

S. China and Japan.



Plate 62. AMELANCHIER SINICA Chun

1. Fruiting branch; 2. Flowering branch; 3. Flower; 4. Stamens; 5. Petal. (4 and 5 enlarged.)



Plate 63. *ERIOBOTRYA JAPONICA* Lindley

1. Flowering branch; 2. Seed; 3. Section of fruit; 4. Fruit.

The fruit has a sweet taste. This is a favorite fruit tree in Southern China, and the only species under cultivation. The tree is very ornamental, with thin, dark green foliage and conspicuous panicles of fragrant flowers which bloom from late summer until the approach of winter. The fruits come into the market toward the last of April and the first part of May. Numerous horticultural varieties have been developed.

SORBUS

Trees or shrubs. Leaves deciduous, alternate, simple, or pinnate, serrate and stipulate. Flowers in compound corymbs; calyx urn-shaped, 5 lobed; petals 5, rounded, white, rarely pinkish; stamens 15-20, anthers red or yellow; carpels 2-5, usually 3, either free and partly superior or connate at the base; ovules 2 in each cell. Fruit a berry-like pome, 2-5 celled, flesh red or reddish-orange, subacid. Seeds 1 or 2 in each cell.

About 80 species, distributed in the Northern Hemisphere. The genus has been referred to *Pyrus* from which it differs by its inflorescence, the flowers being usually perigynous, and by its generally small, berry-like fruits. They are handsome ornamental trees or shrubs with attractive simple or pinnate foliage, clustered showy flowers followed by numerous, small, berry-like, bright, usually red, colored fruits. The fruits of several species are edible.

***Sorbus alnifolia* Koch.**

Chinese Mountain Ash.

Tree 18 m. tall. Bark smooth and gray. Branchlets glabrous or slightly pubescent, reddish, marked by oblong lenticels. Leaves simple, ovate, acute, often acuminate, rounded at base, or occasionally cuneate, serrate, or doubly serrate, thin or slightly leathery, dark green above, pale and more or less pubescent below, 5-10 cm. long. Inflorescence a loose, few-flowered corymb; flowers 7-14 mm. across, white; calyx and peduncles pubescent; stamens exserted. Fruit oblong or subglobose, small, 7-10 mm. long, reddish, tinged with yellow and conspicuously marked by the scar of the deciduous calyx.

Central China, Manchuria, Korea, and Japan. An attractive tree of pyramidal habit with alder-like leaves and reddish fruit produced in great numbers. It is now commonly cultivated in European and American gardens.



Plate 64. *SORBUS ALNIFOLIA* Koch

1. Flowering branch; 2. Fruiting branch; 3. Section of fruit; 4. Section of flower (after Faxon). (Details enlarged).

MALUS

Trees with scaly bark. Leaves deciduous alternate, simple, unevenly serrate, often incised, petiolate, with deciduous stipules. Flowers in terminal cymes on short lateral spurs; calyx 5 lobed, acuminate; petals obtuse, contracted to a stalk-like base, white or pink; stamens usually 20 in 3 series, anthers yellow. Ovary inferior, usually composed of 5 carpels; ovules 2 in each cell. Fruit a pome, flesh homogeneous, surrounding the 5 carpels, which are papery and united at the apex. Seeds 1 or 2 in each cell, ovate, acute with a brown testa, exalbuminous.

Confined to N. America and Asia.

Malus malus (L.) Britton (*Pyrus malus* Linnaeus) (*Malus sylvestris* Miller) of uncertain origin is the parent of the common cultivated apple. The genus is very important both for its commercial value as well as for its ornamental value. *Malus* is characterized by a flower with an open calyx, with a style connate at the base and by a fruit with a depression at either end. No case of hybridizing between *Malus* and *Pyrus* is known.

***Malus baccata* Borkhausen.**

Wild Apple.

Small tree. Leaves ovate to ovate-lanceolate, acuminate, thin, glabrous, finely and irregularly serrate, bright green at the time of opening. Flowers white on slender green pedicels. Styles usually 5, longer than the stamens; calyx lobes lanceolate to acuminate, commonly deciduous as fruit matures. Fruit very small, reddish-yellow, 2 cm. or less in diameter.

Mongolia, Siberia, Manchuria to Chihli and Shensi.

A hardy ornamental species with handsome white flowers which appear with the leaves. The fruits are red or yellow, translucent and never become mellow, remaining on the tree a long time after they are ripe. Pheasants and other birds are very fond of the fruits. This tree should be worthy of extensive cultivation.

***Malus theifera* Rehder.**

Tree about 8 m. tall. Young branchlets minutely pubescent, later glabrous. Leaves deciduous, thin, papery, ovate or ovate-oblong or elliptic-ovate, acuminate, rounded or broadly cuneate at the base, finely serrate with glandular teeth, 6-8 cm. long, 2.5-6 cm. wide, purplish at



Plate 65. *MALUS THEIFERA* Rehder

1. Flowering branch; 2. Fruiting branch.

the time of unfolding, later bright green; petiole channeled above, at first pubescent, 1-3 cm. long. Flowers 3-7 in a fascicle, white or pink, fragrant, 3.5-4 cm. in diameter; calyx acute or acuminate, pedicel and calyx tube reddish-purple; petals 15-18 mm. long, ovate-obtuse; stamens usually 20; styles 3, rarely 4. Fruit globose, apex marked by calyx scar, 8-12 mm. in diameter, greenish yellow, tinged with red, mostly 3 celled. Seeds triangular, ovate, about 5 mm. long.

Chekian, Kiangsu, Hupeh, Shensi, Szechuan, Yunnan south to Assam. Closely related to *Malus halliana*. A very handsome species with pink or white, fragrant flowers on showy red pedicels.

CRATAEGUS

Deciduous shrubs or small trees, usually spiny. Winter buds small, globose with numerous imbricated scales. Leaves alternate, simple, serrate or lobed or deeply pinnatifid, especially on vigorous or sterile leading branches, with petioles and stipules. Flowers usually white, in some varieties pink or reddish, in terminal corymbs, with deciduous bracts; petals 5; calyx lobes 5, campanulate or cup-shaped, adnate to the carpels; stamens usually 10 or 20, but sometimes 5-25, ovary composed of 1-5 carpels, inferior, or its apex free; styles free, 1-5, persistent on the mature carpels; ovules 1 in each carpel, or if 2, dissimilar, that is, one sessile and fertile, the other stalked and sterile. Fruit a pome with 1-5, 1-seeded bony nutlets or stones.

A very large genus, over 600 species having been described, widely distributed throughout the temperate zone but most abundant in the United States of America. Very many species are cultivated as ornamental subjects. They are mostly shrubs or small trees with handsome foliage not subject to insect attacks and have usually showy flowers. In China one species is cultivated for its fruits.

Crataegus pinnatifida Bunge.

Large Fruited Haw.

Shrub or small tree up to 20 m. tall. Branchlets glabrous. Leaves elliptic-ovate, pinnately 5-9 cleft or lobed, serrate, cuneate at the base, dark shiny green above, glabrous beneath, about 6 cm. long with slender petioles. Flowers white, long pedicelled in few-flowered cymes. Fruit globose or pear shaped, with persistent calyx teeth, dark red, spotted, 12-20 mm. long; nutlets 3-5.

Siberia, Korea & N. China.

Var. *major* N. E. Brown is a large-fruited cultivated form common in N. China, around Peking especially. Candied fruits strung on little sticks are commonly vended in the markets.

LEGUMINOSEAE

Leaves alternate, usually compound, occasionally simple, with or without stipules. Flowers papilionaceous, or regular, usually perfect, rarely polygamo-dioecious; sepals 5, more or less united; petals usually 5; stamens definite, monadelphous or diadelphous or indefinite. Carpels 1 (rarely to 15) superior. Ovary 1 celled, ovules 1 to many in the cell. Fruit a legume or a follicle or fleshy. Seeds usually exalbuminous, sometimes albuminous.

A large family of 490 genera and about 7,000 species widely distributed in all temperate and tropical regions, containing numerous representatives that are of great economic importance. Over 100 genera are under cultivation in China. Comparatively few are arborescent.

KEY TO GENERA

Sub-family I *Mimosoideae*. Flowers regular, petals valvate; stamens 5-10 (rarely indefinite) exserted.

- I. Calyx lobes valvate, 5; stamens numerous, somewhat united at the base; pods indehiscent or tardily dehiscent, flat, straight, thin.....*Albizia*.

Sub-family II *Caesalpinioideae*. Flowers irregular, imperfectly papilionaceous or nearly regular; petals imbricate, the upper one inside and inclosed by the others; stamens 10 or fewer, not conspicuously exserted.

- I. Leaves simple cordate; flowers imperfectly papilionaceous; calyx 5 toothed; legume flat, margin slightly winged.....*Cercis*.
- II. Leaves compound; flowers regular:
 - a. Calyx tube elongated, 5 lobed; petals 5; stamens 10, shorter than the petals; legume thick and woody....*Gymnocladus*.
 - b. Calyx tube short, 3-5 lobed; petals 3-5; stamens 3-5; longer than the petals; legume flat, short, leathery.....*Gleditsia*.

Sub-family III *Papilionatae*. Flowers papilionaceous, corolla imbricate, the upper petal (standard) larger and inclosing the other petals; stamens 5-10, included.

I. Stamens 10, distinct.

A. Flowers in racemes:

1. Pods moniliform, seeds brown *Sophora*.
2. Pods linear, 2 valved, sometimes septate; seeds scarlet.
..... *Ormosia*.

B. Flowers in panicles:

1. Winter buds inclosed in the enlarged base of the petiole; leaflets alternate; panicles drooping... *Cladrastis*.
2. Winter buds free; leaflets opposite; panicles upright.
..... *Maackia*.

II. Stamens 9-10, monadelphous; pods ligulate indehiscent, membranous, thin and flat, apiculate, 1-4 seeded..... *Dalbergia*.

ALBIZZIA

Trees or shrubs with large bipinnate leaves composed of numerous small leaflets. Flowers regular, perfect or polygamous in axillary spikes or heads, the heads sometimes paniced. Calyx tubular or campanulate, 5 toothed; corolla small, funnel-shaped; stamens numerous, longer than the corolla, more or less united at the base. Fruit a linear, thin, flat, leathery pod.

About 50 species in the tropics and the subtropic regions of the Old World. They are thornless trees more or less closely allied to the acacias, chiefly interesting for their graceful, feathery foliage and yellow and white or pink, usually capitate flowers.

***Albizzia julibrissin* Durazzini.**

Tree 7-16 m. tall with smooth, pale gray bark and reddish-brown branchlets. Leaves 20-50 cm. long, glandular at the base of the rachis, with 8-24 pairs of pinnate and numerous small, oblong, oblique leaflets. Flowers pink with stamens over 2.5 cm. long, crowded in a short peduncled head about 5 cm. in diameter. Pods 10-25 cm. long, tapered at both ends, papery.

Temperate Asia—Persia to China and Japan. This tree is said to be common in the moist woods of Eastern Szechuan and Western Hupeh and is sometimes planted in the yards of the temples. It has been naturalized in the southern portions of the United States of America.

Albizzia lebbek Bentham.

Tall tree 15 m. in height. Leaves about 25 cm. long with 4-8 pinnae; each pinna with 6-18 leaflets which are coriaceous, obliquely oblong or ovate-obtuse at the apex, and with the midrib towards one side, 3-4.5 cm. long. Flowers in short peduncled axillary heads 3-4 together, greenish-yellow; stamens white and green united only at the base. Pods oblong, flat, coriaceous, shiny, reticulate, 15-20 cm. long.

South China. Cultivated in most tropical countries.

CERCIS

Trees and shrubs. Leaves deciduous, alternate, simple entire, petiolate, stipulate, palmately veined, broad and rounded with a more or less heart shaped base. Flowers papilionaceous, pedicelled, pink or red, appearing in the spring before the leaves, in clusters, from the wood of one or several years' growth. Calyx 5 toothed, persistent; petals nearly equal, pink or rose color; stamens 10, in 2 rows; ovary, oblique at the base of the calyx tube; ovules many; style fleshy. Fruit a flat legume, stalked, oblong or broadly linear, 2 valved, many seeded, dark reddish-purple and shiny.

7 species in Asia, Europe and America. 2 species in China. The 2 Chinese species may be distinguished from one another by the inflorescence. The larger flowers of *Cercis chinensis* are produced in few flowered clusters while the smaller flowers of *C. racemosa* are produced in long pendulous racemes.

Cercis chinensis Bunge.

Tree to 15 m. tall. Bark dark gray and smooth on young trees, rough and broken into small plates when old. Leaves heart shaped, pointed and shiny, pale green beneath, 7-15 cm. across, margin marked by a white transparent line. Flowers 4-10 in a cluster, pink, 2 cm. long. Pod reddish-purple, taper pointed, 8-13 cm. long.

Western Hupeh and Szechuan. Commonly cultivated.



Plate 66. *CERCIS CHINENSIS* Bunge

1. Fruiting branch; 2. Flowering branch; 3. Section of flower; 4. Flower; 5. Pistil and its section; 6. Stamen. (5 and 6 enlarged.)

The flowers appear in early spring before the leaves and are frequently borne on the old wood, even on the trunk of young trees. The papilionaceous blossoms produced in such profusion as to cover the tree with a mass of bloom and the handsome heart-shaped leaves, make this a desirable ornamental plant.

***Cercis racemosa* Oliver.**

Tree to 10 m. tall. Leaves tomentose beneath, slightly smaller than the preceding. Flowers small on slender pedicels of pink in many-flowered drooping racemes. Pods 4-10 cm. long. The most ornamental species of all.

Central China.

GYMNOCLADUS

Trees with stout contorted branches and deeply fissured or thick flaking bark. Leaves deciduous, alternate, bipinnate, with usually alternate pinnae and leaflets; stipules large, deciduous. Leaflets ovate, entire, petiolate. Flowers racemose or in racemose corymbs, dioecious, greenish white or purplish on long slender pedicels. Calyx tubular, lined with a glandular disk, thick ribbed, 5 lobed; petals 4 or 5, pubescent, as long as or slightly longer than the calyx lobes; stamens 10, free, inserted on the disk with the petals; ovary sessile or slightly stipitate, 4 or many ovuled; style short, capitate or 2 lobed. Pods oblong, thick, tipped, slightly curved, tardily dehiscent into 2 woody valves, pulpy between the seeds. Seeds ovoid to subglobose attached to a slender funicle; testa hard and bony.

2 species, 1 in temperate N. America, the other in Southern and South-western China.

***Gymnocladus chinensis* Baillon.**

Tree 12 m. high. Bark smooth and light gray on young trees. Branchlets pubescent. Young leaves silvery, mature leaves pale green; leaflets numerous, 20-24, pubescent beneath, oblong, obtuse rarely acute at the apex, rounded at the base, on short pubescent petiolules. Inflorescence polygamous, in pubescent racemes. Flowers white or purplish; calyx pubescent; petals ovate-oblong; ovary glabrous; style short, crowned by a somewhat capitate stigma; ovules few, mostly 4. Pods flat, brown, glabrous, 7-10 cm. long, 3-4 cm. wide. Seeds 2-4, 2 cm. in diameter, globose, smooth, black.



Plate 67. *GYMNOCLADUS CHINENSIS* Baillon

1. Fruiting branch; 2. Section of male flower; 3. Stamen; 4. Section of perfect flower; 5. Flowering branch. (3 enlarged.)

Anhwei, Chekiang, Kiangsu, Hupeh and Szechuan.

The pods of this tree are saponaceous and are used as a substitute for soap for laundry purposes. A perfumed soap of high quality for the washing of hair and delicate fabrics is made with the addition of honey, sandal wood, camphor, musk and several other ingredients. This preparation is also valued as a comestic or salve. The seeds, after the black coat is removed by steaming, are used by embroiderers to gloss silk threads in much the same way as wax is used for the same purpose.

GLEDITSIA

Deciduous trees with inconspicuous buds scarcely raised above the bark. Branches and trunks often armed with branched or simple spines. Leaves alternate, pinnately or bipinnately compound; stipules deciduous. Leaflets irregularly crenate. Flowers dioecious or polygamous, greenish-white, in lateral simple or fascicled racemes. Calyx lobes and petals 3-5; stamens 6-10, exserted; ovary usually 1 celled; ovules 2 to many; style short, with large terminal stigma. Pods mostly large and indehiscent, pulpy, compressed, walls thin and membranous or pulpless and ovate, tardily dehiscent, or inhediscent with woody walls; seeds many or rarely few, ovate or compressed, attached by a long slender funicle.

About 12 species known in C. and E. Asia, N. and S. America, and tropical Africa. The genus yields a wood that is fairly hard and durable but coarse grained. When planted close together and severely pruned most Gleditsias form good windbreaks and hedges. They are late in developing leaves in spring. Also spelled gleditschia.

Gleditsia macracantha Desfontaines.

Honey Locust.

Tree 15 m. tall. Branchlets glabrous; spines terete, reddish-brown, simple or compound with 1 or 2 or more branches. Leaves pinnate; rachis pubescent along the grooves; leaflets 6-12, reticulate beneath, midrib and petiolules pubescent, ovate to ovate-lanceolate, 5-8 cm. long, diminishing in size toward the tip of the leaves. Flowers polygamodioecious, in racemes, pubescent, 6-13 mm. long on slender pedicels. Pod 10 to 15 cm. long, 3 cm. wide, often cylindrical, indehiscent, straight, slightly convex, purplish-brown, many seeded.

Hupeh and Szechuan.

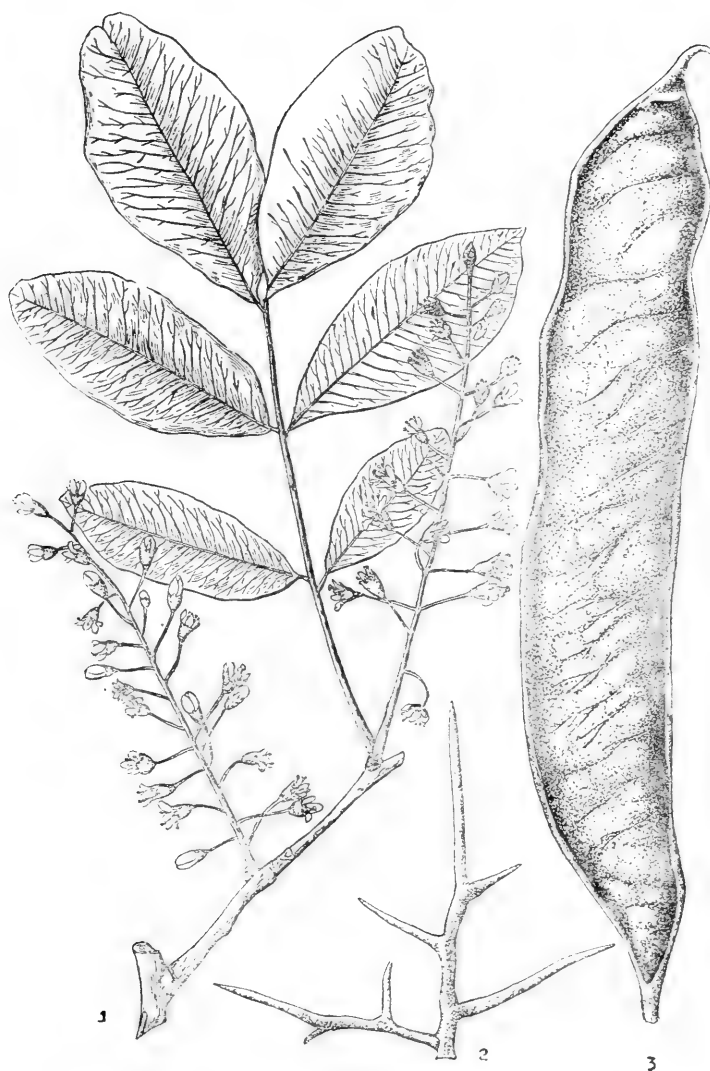


Plate 68. *GLEDITSIA MACRACANTHA* Desfontaines

1. Flowering branch; 2. Thorn; 3. Pod.

The pods of *Gleditsia sinensis*, *G. macracantha* and *G. japonica* are used as a substitute for soap. A medicine is made from the immature pods of *G. officinalis*.

Individuals or forms of *Gleditsia* are found which are almost or wholly free from spines.

***Gleditsia sinensis* Lamarek.**

Tree 13 m. tall. Leaves rarely bipinnate. Spines terete. Leaflets 8-18, ovate-oblong, yellowish above, dull green below. Flowers on pubescent racemes; ovary glabrous. Pod straight, walls thick, woody, 10-22 cm. long.

Central China.

Allied to *G. macracantha*, but the leaves and spines are smaller.

***Gleditsia delavayi* Franchet.**

Spines compressed at the base. Leaflets 12-18, ovate, oblique, dark green, glabrous. Pods with leathery walls, 30-45 cm. long, twisted.

S. W. China: Yunnan.

***Gleditsia japonica* Miquel.**

Tree 20 m. tall. Branchlets purplish with compressed, branched spines, and 16-20 leaflets; bipinnate leaves with 8-12 pinnae. Leaflets ovate-lanceolate, obtuse. Pods flattened, leathery, 20-30 cm. long, brown, twisted.

Japan, Korea, Manchuria and China.

SOPHORA

Deciduous or evergreen trees, shrubs and perennial herbs. Leaves alternate, odd pinnate with deciduous, entire stipules. Leaflets entire, mostly opposite, numerous and small or few and large. Flowers in racemes or terminal panicles, papilionaceous, white, yellow, violet or pink; calyx campanulate, slightly 5 toothed; standard broadly ovate or orbicular; wings oblong, oblique; keel petals oblong, as long as or longer than the wings, barely connate; stamens 10, slightly connate at the base; ovary sessile, with curved style and rounded stigma; ovules indefinite. Legume or pod moniliform (necklace like), the seeds

separated by marked constrictions in the pods, almost terete or slightly compressed or 4 winged, fleshy, coriaceous or woody, indehiscent.

22 species distributed throughout the warm parts of the world. About 4 ligneous species occur in China.

***Sophora japonica* Linnæus.**

(Hua Shu.) Pagoda Tree.

Tree 18 m. tall with tortuous branches and angled dark green branchlets. Leaves deciduous, alternate, odd pinnate, 18–22 cm. long; leaflets 7–17, entire, 2.5–5 cm. long, stalked, opposite, ovate to ovate-lanceolate, acute, rounded at the base, dark green above, more or less pubescent below. Flowers appearing in midsummer in large terminal panicles, yellowish-white, sometimes tinged with purple, 1.3 cm. long. Pod long stalked, terete, constricted between the seeds, glabrous, 5–8 cm. long, tipped with a slight beak. Seeds dark brown, ovate.

Peking to Hongkong, Kansu to Yunnan.

Introduced to Japan. The wood is light and tough, used in carpentry. The flowers and buds yield a yellow dye and the pods an important medicine. The preparation of the dye is very simple. The flowers and buds are baked in an oven until they turn brown, then placed in a pot of cold water and brought to a boil. The liquid is poured into the vats ready for use. The bark, wood and roots contain a purgative property. A fine avenue of *Sophora japonica* may be seen in the grounds of the Temple of Heaven in Peking. A pendulous form is often planted.

Propagated by seeds and cuttings. A pound of seeds contains between 3,180 to 4,140 seeds. Germination is slow and uneven.

ORMOSIA

Trees. Leaves odd pinnate; leaflets coriaceous. Flowers usually in terminal racemes, papilionaceous; calyx 5 cleft, campanulate; corolla slightly exserted; petals clawed; stamens free, unequal, incurved, exserted in the opening blossom; ovary subsessile; style long, filiform; stigma oblique; pods leathery, woody or fleshy, oblong to linear, 2 valved, sometimes septate, sutures not winged. Seeds with bright scarlet testa.

About 40 species, mostly in the tropics.



Plate 69. *SOPHORA JAPONICA* Linnæus

1. Fruiting branch; 2. Flowering branch; 3. Section of pod.

***Ormosia hosiei* Hemsley & Wilson.**

Red Bean Tree. (Hung Tou Shu.)

Tree to 20 m. tall with smooth gray bark. Leaves odd pinnate, 18-20 cm. long; leaflets 5-7, oblong to oblong-ovate, acuminate, dark green above, glabrous. Panicles terminal or axillary, few flowered; flowers fragrant, white to rosy pink; calyx cup-shaped, 8-10 mm. long, tomentose; petals about 2 cm. long; ovary glabrous, yellow-green; 5-6 ovuled. Pods brown, woody, compressed, beaked, 4-6.5 cm. long, 2.5-3 cm. broad. Seeds 1-2, bright red.

Central and Western China.

The bright red seeds are sometimes strung into necklaces. The wood is reddish, handsomely marked, hard and heavy, one of the most valuable woods for furniture and carving.

***Ormosia henryi* Hemsley & Wilson.**

Tree 6-9 m. tall. Leaflets 5-9, elliptic or oblong-lanceolate, coriaceous, 7-12 cm. long, 2-5.5 cm. wide. Young shoots, lower surface of the leaves, and inflorescence tomentose. Flowers yellowish-white; ovary pilose. Pods 7-11 cm. long, 2-3 cm. wide, blue-black, slightly beaked, 8-10 seeded. Seeds 8-15 mm. long, more or less imbedded in the corky tissue of the seed coat.

Chekiang and Kwangtung.

Chiefly valuable as an ornamental tree. The wood is light yellow.

CLADRASTIS

Deciduous trees with smooth gray bark and naked axillary buds, several appressed together, one above the other, and enclosed in the hollow base of the petiole. Leaves alternate, odd pinnate, with petioles enlarged at the base; leaflets 7-13, ovate, entire, alternate or subopposite. Flowers in long panicles or racemes on slender pedicels, papilionaceous, white; calyx campanulate, 5 toothed; stamens 10, free or slightly united at the base; ovary with numerous ovules. Pods linear, flattened, thin, membranous, 3-6 seeded.

2 species, 1 in N. America and 1 in China. They are medium-sized trees cultivated for their white, fragrant flowers and for their foliage, which in the autumn turns a brilliant yellow. The wood is hard

and heavy, close grained and takes a high polish. The wood of the American species is sometimes used for gun stock. It also yields a yellow dye.

***Cladrastis chinensis* Hemsley.**

A medium-sized tree sometimes 25 m. tall with smooth, gray-green bark and young shoots pubescent toward the base. Leaflets 9-13, oblong to oblong-lanceolate, entire, usually rounded at the base, blunt or acute at the apex, yellow-green, pubescent below along the midrib and toward the base, 5-11 cm. long. Flowers about 12 mm. long, white or pinkish white, fragrant, in large, loose, much branched, erect, terminal, rusty pubescent panicles, 13-30 cm. long, sometimes 20 cm. wide. Stamens slightly connate at the base. Pods oblong, thin, papery with thickened edges.

Szechuan, Yunnan and Hupeh.

A handsome tree on account of its showy flowers which are fragrant, white or pinkish white in color. This tree resembles somewhat *Sophora japonica* in appearance. *Cladrastis chinensis* is a comparatively rare tree but it is well worthy of cultivation as an avenue or lawn tree and perhaps for timber. It is cultivated in Europe and America.

MAACKIA

Deciduous trees or rarely shrubs with axillary scaly buds. Leaves alternate, odd pinnate; leaflets entire, opposite or subopposite, short stalked. Flowers white, papilionaceous in terminal erect panicles; calyx 4 or 5 toothed, campanulate; stamens 10, more or less connate. Pods 1-5 seeded.

2 or 3 species in Eastern Asia. Distinguished from *Cladrastis* by the scaly buds not enclosed in the leaf base, and by the opposite leaflets.

***Maackia amurensis* (Koch) Ruprecht.**

(*Cladrastis amurensis* Koch.)

Tree to 15 m. tall with bark peeling in thin lateral strips. Buds scaly, shiny brown. Leaflets 7-11, elliptic-ovate or oblong-ovate, acute or obtuse, rounded at the base, glabrous, dark green, 5-8 cm. long. Racemes many flowered, usually paniced, 10-20 cm. long; flowers

greenish-white, about 8 mm. long on slender pedicels. Pods 4-8 cm. long, brown, oblong, flattened. Seeds 1-5; oblong.

Amurland, Manchuria, China and Japan.

The wood is yellowish-brown, hard and tough, fine textured, suitable for building and furniture, for making agricultural implements, saddles, etc., and for railroad ties. The bark yields a yellow dye.

Propagated by seeds. About 9,950 seeds weigh 1 pound.

***Maackia hupehensis* Takeda.**

Tree to 23 m. tall. Bark greenish-gray. Leaflets 11-13, 2-3 cm. long, ovate to ovate-elliptic, densely hirsute. Flowers numerous, white, about 10 mm. long.

Hupei, Szechuan, Kiangsi.

According to E. H. Wilson, the bud scales in the spring are bluish with yellow margins. The unfolding leaves are silver gray.

DALBERGIA

Trees, shrubs or climbers. Leaves coriaceous, odd pinnate or rarely 1 foliate. Flowers papilionaceous, numerous, small, in terminal or axillary panicles; calyx campanulate, 5 toothed; standards ovate or orbicular; stamens 9-10, monadelphous or with a split sheath; anthers minute; ovary stipitate, few ovuled; style short, incurved with capitate stigma. Pods oblong or ligulate (strap shaped) usually thin and flat, indehiscent, 1-4 seeded.

About 70 species, mostly in the tropics. 9 or 10 species in China.

***Dalbergia hupeana* Hance.**

Tian Shu.

Tree to 20 m. tall with rough gray bark peeling in thin flakes. Leaflets 9, oblong, rounded at both ends or emarginate at the apex, veins elevated on the under surface, glabrous, usually about 4 cm. long (up to 7 cm.). Panicles glabrous, compact; flowers yellow or creamy white, small, about 1 cm. long; calyx hairy, 4 toothed, the upper teeth obtuse, the lower tooth elongated; corolla about 1/2 the length of the calyx; stamens diadelphous; ovary glabrous, 3 ovuled. Pod ligulate, flat, minutely apiculate, 1-3 seeded, up to 8 cm. long.

Hupei and Szechuan, and Kiangsu.

A very valuable timber tree usually of medium size. The wood is white or yellowish, close grained and very heavy. It is used for making wheelbarrows, axles, pulley blocks, tool handles and oil presses, and may well be adapted to street paving.

RUTACEAE

Trees or shrubs or herbs usually containing aromatic essential oil. Leaves alternate, rarely opposite, simple or compound, usually with pellucid, oily glands. Flowers perfect, regular, cymose or paniculate; sepals 4-5, often connate, imbricated; petals 4-5, usually free; stamens 4-5 or 8-10, rarely 15 or more, inserted at the base of the disk, filaments usually distinct; ovary superior, 2-5 lobed, 2-5 celled on a stalk with a glandular disk at the base; ovules 1 to many in each cell; style more or less connate. Fruit a fleshy drupe or berry, or a capsule or separating into several drupelets, rarely winged.

About 100 genera and 900 species, mostly tropical. The volatile fragrant oils, characteristic of this family, are much used in perfumery and medicine. A very important family horticulturally and commercially.

KEY TO GENERA

- I. Fruit a berry with leathery rind and cells distended with juicy pulp; orange-like.
 - A. Leaves simple, persistent *Citrus*.
 - B. Leaves trifoliate, deciduous..... *Poncirus*.
- II. Fruit not orange-like, but drupaceous or capsular.
 - A. Fruit capsular.
 1. Leaves alternate; plants often armed.... *Zanthoxylum*.
 2. Leaves opposite; plants unarmed *Evodia*.
 - B. Fruit drupaceous; winter buds inclosed by the base of the petiole; leaves odd-pinnate..... *Phellodendron*.

PHELLODENDRON

Deciduous trees, sometimes with thick, corky bark. Winter buds naked, enclosed by the base of the petiole. Leaves opposite, odd pinnate,

petiolate, without stipules; leaflets opposite or alternate, crenate serrate, stalked. Flowers small, dioecious, in erect terminal panicles; calyx 5 lobed, triangular, persistent for a time under the fruit; petals 5-8, ovate-lanceolate, longer than the calyx lobes, yellow-green; staminate flowers with 5 stamens; pistillate flowers composed of 5 carpels; ovary 5 celled; style short and thick. Fruit a black drupe, borne on an erect panicle; flesh black, aromatic, enclosing 5 small, 1 seeded stones.

5 or 6 closely related species in E. Asia.

The leaves of *Phellodendron* when bruised give off an aromatic odor. The leaf stalk has a swollen base which completely envelopes the bud. The outer bark is often corky and ridged, used occasionally for the floating of fish nets. The inner bark is bright yellow, used in medicine under the name of Huang-po. The seeds are bitter, also medicinal, and in addition are said to be useful as an insecticide.

Phellodendron amurense Ruprecht.

Tree 15 m. tall. Bark gray, corky and deeply fissured. Branchlet orange yellow. Buds covered with silky pubescence. Leaves from 20-30 cm. long; leaflets 5-11 (13), ovate or ovate-lanceolate, long pointed, rounded or cuneate and unequal at the base, ciliate along the margins, bright green above, hairy only along the midrib or glabrous below, 6-10 cm. long, 2-3.5 cm. wide, turning yellow in the autumn. Inflorescence at first puberulous, about 8 cm. long. Fruiting panicles 8-12 cm. long and 4-6 cm. wide; fruit 10-12 mm. in diameter, black, aromatic when bruised.

Amurland, N. China and Japan.

The wood is pale brown in color with thin sap wood and wide bands of pores marking the annual growth; used for the making of furniture and small articles. In Japan the wood is valued for rifle-stocks. A yellow pigment, extracted from the bark, is employed in the manufacture of documentary paper, the pigment rendering the paper insect proof. This species has been recommended for planting in city streets as it is free from insect attacks, resistant to drought and heat and is not particular as to soil. *Phellodendron amurense* is fairly rapid growing when young.

Phellodendron sachalinense Sargent.

Tree 15 m. tall. Bark brownish, not corky. Branchlets brown. Leaflets 7-11, ovate to ovate-oblong, dark green above, often glaucous



Plate 70. *PHELLODENDRON SACHALINENSE* Sargent.

1. Fruiting branch; 2. Staminate flower; 3. Pistillate flower; 4. Section of fruit; 5. Pistillate flowering branch; 6. Staminate flowering branch. (Details enlarged.)

below, 8-12 cm. long, 3-5 cm. wide. Inflorescence glabrous. Fruit 8-10 mm. in diameter.

Saghalien, Korea, Japan and W. China.

Phellodendron chinense Schneider.

Tree 8 m. tall. Bark gray-brown, not corky. Branchlets purple-brown. Leaflets 7-13, oblong-ovate to oblong-lanceolate, dull yellow-green above, villose beneath, 9-14 cm. long. Inflorescence densely pubescent. Fruit black, 12 mm. in diameter in compact panicles 5-8 cm. long and 2.5-6 cm. wide.

Central China.

CITRUS

Evergreen shrubs or small trees, usually armed with spines. Leaves alternate, pinnate but apparently simple, persistent, coriaceous, punctate, borne on a winged and articulated petiole. Flowers white or pinkish, fragrant, axillary, fascicled or in small cymes, rarely solitary. Calyx 3-5 parted, cup or urn shaped; petals 5, (4-8), linear-oblong, thick, imbricate; stamens 20-60, inserted on the disk, variously connate; ovary many celled (8-15), style stout, usually deciduous, with capitate stigma; ovules 4-8 seriate in each cell. Fruit a large, globose or oblong berry with a leathery rind and many cells distended with a juicy pulp; cells 1-8 seeded; seeds large, up to 2 cm. long, oval or oblong.

Extensively cultivated in tropical and subtropical Asia and elsewhere. About 6 species are recognized. The leaves are unifoliate by suppression as indicated by the articulated blade. This is the most important genus of the family, including valuable economic fruits such as the orange, tangerine, pomelo or grape fruit, lemon and lime.

Citrus medica Linnæus.

Citron.

Thorny shrub or small tree. Leaves to 18 cm. long, oblong, rounded at the apex, not articulated; petiole wingless. Flowers large, white, tinged with reddish purple. Fruit large, oval or oblong, 15-25 cm. long, lemon yellow; skin thick, fragrant; pulp acid and scanty.

Var sarcodactylis Swingle.

Fo Sho or Fingered Citron.

C. limonia Osbeck.

Lemon.

C. grandis Osbeck.

(C. decumana Linnaeus).

Grape Fruit and Pomelo.

C. sinensis Osbeck.

Sweet orange.

C. nobilis var **deliciosa** Swingle.

Mandarin Orange and Tangerine.

PONCIRUS

Trees or shrubs with green, shiny branchlets armed with stout, straight thorns. Leaves deciduous, trifoliate; leaflets sessile, elliptic, coriaceous, crenulate, glandular dotted. Flowers before the leaves, solitary, sessile on the axil of the spine, 2.5 cm. across; sepals 4 or 5, small deciduous; petals 4 or 5, white, obovate, narrowed at the base; stamens 8-10; inserted on an annular disk, filaments free or partly connate, reddish below; ovary globose, 6-8 celled. Fruit a small orange, densely pubescent.

The genus differs from *Citrus* with which it is sometimes united by the trifoliate, deciduous leaves, by the flower buds which are developed in the summer, and by other minor taxonomic characters.

Poncirus trifoliata (L.) Rafinesque.

(Citrus trifoliata Linnaeus).

Kou Chu. Trifoliate Orange.

A shrub or small tree, native of Northern China, widely cultivated. The bitter fruit is used in medicine. The plant is frequently planted for hedges, and often used as stock, upon which oranges and other Citrus fruits are grafted. This species is a host to numerous insects and several fungous diseases, rendering it undesirable for hedges or other forms of ornamental planting.

The flowers are very fragrant.

EVODIA

Tree or shrubs. Winter buds naked. Leaves opposite, simple, trifoliate or pinnately compound; leaflets entire, punctate. Flowers small, dioecious in axillary or terminal panicles or corymbs; sepals and

petals 4 (5); stamens 4-5, inserted at the base of the disk; ovary usually deeply 4 lobed, 4 celled; ovules 2 in each cell; style 4 lobed. Fruit composed of 4 coriaceous, 3 valved cocci, 1-2 seeded.

About 50 species in E. & S. Asia to Australasia, and the South Sea Islands. In habit and appearance *Evodia* resembles *Phellodendron*, but it is distinguished by the naked buds and capsular dehiscent fruits displaying shiny black seeds at maturity.

***Evodia glauca* Miquel.**

Tree to 16 m. tall with smooth bark. Leaflets usually 7 (5-11), elliptic-ovate to oblong-lanceolate, long pointed, cuneate or rounded at the base, glaucous below, 5-10 cm. long on short, hairy, slender stalks. Flowers white in a much branched corymb. Fruit about 9 mm. long, finely pubescent.

Central China: Kiangsi, Hupeh.

A very common tree in W. Hupeh. The wood is brittle.

ZANTHOXYLUM

Deciduous or evergreen shrubs or trees, often armed with prickles. Leaves alternate, odd pinnate, 3 foliate or rarely unifoliate; leaflets entire or crenate serrate, punctate. Flowers dioecious or polygamous, regular, small, in cymes or panicles. Calyx 3-8 parted, rarely absent; petals 3-8; stamens 3-8, inserted with the petals; pistils 3-5, distinct or connate; style free or connate, with capitate stigma; ovules 2 in each cell. Fruit composed of 1-5 globose, coriaceous capsules, dehiscing ventrally, each carpel containing 1 or 2 hard, shiny, blue or black seeds.

About 150 species in the tropics and warm temperate regions of both hemispheres. The genus contains several shrubby species with aromatic or bitter properties useful in medicine or as condiments.

***Zanthoxylum micranthum* Hemsley.**

Tree sometimes 15 m. tall with dark trunk armed with stout prickles. Branchlets spiny. Leaves pinnate, 13-26 cm. long; petiole channeled above; leaflets 7-11, opposite or subopposite, lanceolate, long acuminate, base rounded, slightly oblique, minutely dentate, pellucid

glandular, glabrescent, short stalked, 8-13 cm. long. Inflorescence broad, 10-30 cm. across, many flowered. Flowers small, short stalked; sepals, petals and stamens 5. Fruit 1-3, punctate; seeds 1 to each carpel, black.

Hupei and Szechuan.

All parts of this tree exhale an astringent, aromatic odor when bruised.

Zanthoxylum piperitum DeCandole.

Shrub or small tree. Prickles slender ascending, in pairs. Leaves to 15 cm. long with 11-19 leaflets; leaflets ovate to oblong-ovate, emarginate at the apex, remotely toothed; teeth glandular at the base. Flowers after the leaves on short lateral branches, corymbose, to 4 cm. across. Fruits reddish, glandular dotted.

N. China, Korea & Japan.

The seeds, leaves and inner bark are employed as spices. The wood is yellow grained, heavy and hard, used for making utensils.

Zanthoxylum bungei Planchon.

Pepper Bush. (Hua Chiao.)

A shrub, cultivated for its fruits, which are used as condiments.

Hupei, Szechuan, Shensi and Chihli.

There are several other species, all shrubby, in this country.

SIMARUBACEAE

Trees or shrubs. Leaves alternate, rarely opposite, pinnate or simple. Inflorescence axillary; flowers unisexual, regular, usually small; sepals 3-5, more or less connate; petals 3-5, rarely absent; stamens as many as or twice as many as the petals; filaments free, naked, or with a scale, inserted at the base of the disk; ovary superior, 1-6 celled, composed of distinct or more or less united carpels, rarely entire; ovules 1 to several in each cell. Fruit drupe-like or a berry, or a samara.

About 28 genera and 140 species in the tropics and the subtropical regions. The 2 following genera are the only arborescent representatives of the family in China.

KEY TO GENERA

- I. Stamens 10, twice as many as the petals; fruit a samara..... *Ailanthus*.
- II. Stamens 4-5, as many as the petals; fruit a berry-like drupe.... *Picrasma*.

AILANTHUS

Deciduous, coarse-branched trees with large compound leaves. Flowers polygamous, or dioecious, small and inconspicuous in large terminal panicles, with 5 sepals and 5 petals on a 10 lobed disk. Stamens 10 in the staminate flower, 2-3 in the perfect flower, and absent or 2-3 in the pistillate flower; ovary 2-5, more or less distinctly cleft, rudimentary in the staminate flower; ovules 1 in each cell. Fruit 1-5 samaras, each composed of a seed, surrounded by a large, membranous wing. The large terminal clusters of the fruit are often very conspicuous in autumn and winter.

About 11 species, mostly in the tropics of China, India, Malay and Australia.

***Ailanthus altissima* Swingle.**

(*Ailanthus glandulosa* Desfontaines.) Chou C'hun.

Tree up to 30 m. tall with smooth, gray or brownish bark marked by shallow, pale colored, longitudinal fissures. Leaves odd pinnate with 7-9, or more pairs of leaflets. Leaflets ovate-lanceolate, pointed, green, with entire margins except 1-4 pairs of glandular teeth near the base. The leaves have a disagreeable odor when bruised and the same disagreeable odor is exhaled by the staminate tree at the time of the shedding of the pollen. The samara is oblong, red or purplish-brown, with the wing slightly twisted at the base each side of the seed which imparts to it a spiral motion when detached and falling through the air.

Wild in the mountains of Chihli; elsewhere cultivated. Introduced into India, England, France, Germany, Italy and the United States of America. In France this tree is used to hold railroad embankments. *Ailanthus* is a rapid growing tree attaining a large size in China, but the wood is soft and light, suitable only for such uses as do not require strength and durability. The wood is greenish-white or yellow, easily worked and



Plate 71. *AILANTHUS ALTISSIMA* Swingle

1. Flowering branch; 2. Fruits.

susceptible of a high polish, said to make handsome furniture, on the authority of Professor C. S. Sargent. In China it is used for general carpentry as well as for fuel. From the roots, an infusion is derived for medicinal uses. *Ailanthus* reproduces freely by seeds, sprouts and root suckers and single trees often produce large colonies from the latter. Often planted in cities on account of its indifference to drought, smoke and other unfavorable factors. A wild silkworm *Attacus cynthia* is fed on the leaves of this and of the following species:—

***Ailanthus vilmoriniana* Dode.**

Tree to 15 m. tall. Young branchlets and petioles pubescent and prickly when young, the prickles or spines usually disappear when the tree approaches maturity. Leaflets 17–35, oblong-lanceolate, 10–15 cm. long, with 2–4 glandular teeth near the base, glaucous and pubescent beneath. Fruits about 5 cm. long.

W. China.

PICRASMA

Trees or shrubs with bitter properties. Leaves alternate, odd pinnate, large. Flowers unisexual or polygamous, in axillary cymes or panicles, yellow-green; calyx 4–5 toothed; petals 4–5; stamens 4–5, without scales; ovary 3–5 parted, free; style united in the middle; ovules solitary. Fruit a dry or fleshy, berry-like drupe.

About 8 species in India, China and S. & E. Australasia. *Picrasma quassioides* is known as Ku lien Shu and the bark is used as a medicine.

***Picrasma quassioides* Bennet.**

(*Picrasma ailanthoides* Planchon.)

Shrub or tree to 10 m. tall. Leaves long, with 4–8 pairs of leaflets; leaflets ovate to oblong-ovate or obovate, acuminate, serrate, 6–9 cm. long, glabrous. Inflorescence tomentose, paniculate; flowers polygamous, green; sepals and stamens 5; petals strap-shaped, deciduous in the staminate flower. Fruit usually 3 together, bright red, the size of a pea, 1 seeded.

Himalayas to China and Japan. Szechuan, Hupeh, Shensi, Shantung, Kiangsi.

The foliage turns bright red and orange in the autumn. The bark and wood have an extremely bitter property.

BURSERACEAE

Resinous trees or shrubs. Leaves generally alternate, odd pinnate, 3 foliate or rarely simple; stipules absent. Flowers small and mostly numerous, regular, perfect or polygamous; sepals 3-5, more or less united; petals 3-5. Stamens as many as, but more often twice as many as the petals, inserted on the edge or at the base of the disk; disk annular, cup-shaped or rarely absent. Ovary superior 2-5 celled; ovules usually 2 in each cell. Fruit drupe-like, indehiscent with a 3-6 celled hard stone, or dehiscent into valves with several stones. Seeds exalbuminous.

A family containing 16 genera and about 270 species widely distributed throughout the tropics. The bark yields a fragrant resin of commercial importance.

CANARIUM

Evergreen, resinous trees. Leaves alternate, odd pinnate with or without stipules. Flowers perfect or polygamous in terminal or axillary panicles. Calyx cup-shaped or campanulate, usually 3 (rarely 5) parted or lobed; petals 3-5; stamens 6, rarely 10, distinct, inserted on the margin or outside of the disk, or connate by their filaments into a tube. Ovary 2-3 celled; ovules 2 to each cell. Fruit drupe-like, ovoid, slightly 3 sided, with a 1-3 celled, 1-3 seeded stone.

About 50 species in the tropics of Asia and the Malay Archipelago. Represented in China by 2 species cultivated as fruit trees and generally known as Chinese Olives, although the true olive of the Mediterranean regions belongs to another family.

***Canarium album* Raeuschel.**

Bah Lam. "Chinese Olive."

Tree sometimes attaining a height of 20 m., usually 6-9 m. high with whitish bark and rounded crown. Leaves odd pinnate; leaflets 11-13, oblong-lanceolate, 6.5-10 cm. long, about 4 cm. wide, finely reticulated above. Flowers in simple racemes, small, short stalked. Fruit ovoid, slightly larger than round, greenish-white when ripe, about 3.5 cm. long, sessile. Stone pointed, slightly angled and grooved.

This tree produces the Bah Lam of commerce in its various forms. *Canarium pimela* Konig is the so-called Chinese Black Olive. Both species occur in a wild state in the Island of Hainan. Hitherto unknown except under cultivation.



Plate 72. *CANARIUM ALBUM* Raeuschel

1. Flowering branch; 2. Fruits.

MELIACEAE

Trees or shrubs. Leaves alternate, generally pinnate, rarely simple, without stipules. Flowers mostly perfect, regular, paniced. Calyx 4-5 cleft. Petals 4 or 5, partly connate, or free. Stamens usually twice as many as the petals, commonly connate into a tube. Ovary superior, 3-5 celled, more or less surrounded at the base by the annular disk; ovules 1-2 or numerous in each cell. Style and stigma simple. Fruit a capsule, drupe or berry. Seeds with or without albumen.

Composed of about 40 genera, mostly distributed in the tropics. The most important member of the family is *Swietenia mahogani* of Peru and the West Indies, which yields the valuable mahogany wood of commerce. The bitter bark of this tree has also been used as a substitute for quinine.

KEY TO GENERA

- A. Fruit drupaceous; stamens connate.
 - I. Leaves pinnate; inflorescence in subglobose panicles; ovary 5 celled; cells 1-2 seeded.....*Cipadessa*.
 - II. Leaves (in our species) bipinnate; inflorescence in open panicles; ovary 3-6 celled; cells 1 seeded.....*Melia*.
- B. Fruit capsular; stamens free; seeds numerous, winged.. *Cedrela*.

CEDRELA

Trees. Leaves deciduous, alternate, usually odd pinnate, without stipules. Leaflets opposite or sub-opposite, entire or slightly serrate, short stalked. Flowers in terminal, pendulous panicles, inconspicuous, white, usually perfect, regular. Calyx 4-5 cleft; corolla of 4-5 petals. Stamens 4-5, free, inserted on the edge of the disk, shorter than the petals. Style single, capitate or lobed. Ovary 5 celled; ovules 10-12 in each cell arranged in 2 series. Fruit a capsule, dehiscent imperfectly into 5 valves with a large white, pithy, 5 celled or angled central column on which the seeds are disposed. Seeds numerous, winged.

16 species in Asia, tropical America, and Australia. The fragrant wood of *Cedrela odorata*, native of the West Indies, is extensively employed for the making of cigar boxes. The aroma which the wood exhales is said to improve the flavor of cigars.

Cedrela sinensis Jussieu.

Shiang Chun.

Tree 25 m. tall. Leaves often 25-60 cm. long, long petioled. Leaflets 10-22, opposite or subopposite, stalked, oblong or oblong-lanceolate, acuminate, remotely serrate, unequally divided by the midrib, dark green above, pale green below, 10-20 cm. long. Flowers white, fragrant in long terminal, pendulous panicles. Calyx 5 lobed, rounded; petals 5, oblong, converging at the apex. Stamens 5, alternate with 5 staminodes. Ovary glabrous. Capsule oblong or ovate, about 2.5 cm. long, longitudinally dehiscent. Seeds with a long oblong wing on the upper side.

Central and Western China. Introduced into Europe and America.

The feathery foliage and the compact habit of growth make this a valuable tree for street planting. The young shoots are edible when cooked as a vegetable. The wood is yellow-brown, banded with red, used for high grade furniture and for interior finish, known to foreign residents of China as "Chinese mahogany."

Often confused with *Ailanthus*, which is distinguished by the few glandular teeth at the base of the leaflets.

MELIA

Deciduous trees. Leaves bipinnately, tripinnately or pinnately compound. Leaflets acuminate. Flowers in panicles. Calyx 5-6 parted, short; petals 5-6, linear. Stamens 10-12, monadelphous. Ovary 3-6 celled; 2 ovules in each cell. Fruit a dry or fleshy drupe. Stone 5 celled. Seeds solitary in each cell.

Asia and Australia. A small genus of probably not more than 2 species. Authors have founded several species, based upon slight variations of foliage, size of inflorescence and fruit in the common and widely distributed *M. azederach*, but the diagnostic characters exhibit all degrees of intermediate gradations, making the species and varieties untenable. The principal synonymy follows:—

Melia azederach Linnæus.

China Berry or Pride of India.

(*M. florida* Salisbury; *M. sambucina* Blume; *M. australis* Sweet; *M. japonica* G. Don; *M. buxayun* Royle; *M. cochinchinensis* Roemer; *M. orientalis* Roemer; *M. toosendan* S. & Z.; *M. composita* Benthall; *M. chinensis* Siebold; etc.)



Plate 73. CEDRELA SINENSIS Jussieu

1. Flowering branch ; 2. Fruits ; 3. Seed ; 4. Flower ; 5. Stamen ;
6. Leaf, much reduced. (Details enlarged.)

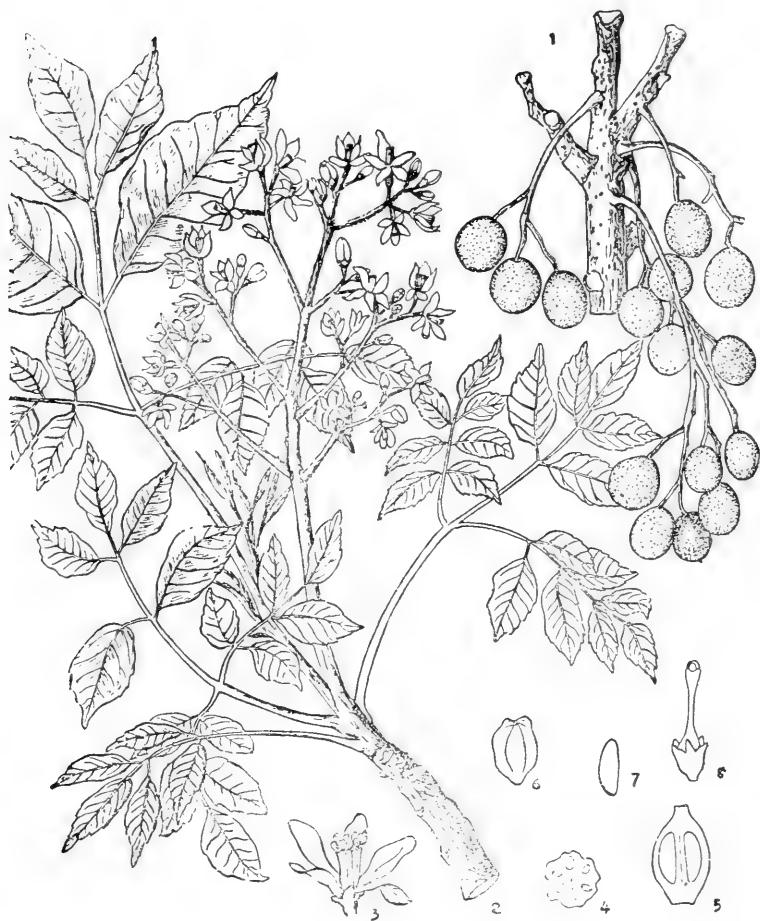


Plate 74. *MELIA AZEDERACH* Linnaeus

1. Fruiting clusters; 2. Flowering branch; 3. Flower; 4. Section of stone; 5. Section of ovary; 6. Stone; 7. Seed; 8. Ovary.
(Details enlarged.)

Tree 16m. tall. Leaves twice or thrice compound. Leaflets oval, elliptic, acute, margin very variable, entire to sharply toothed or incised. Flowers showy, purplish with a lilac-like fragrance in panicles 10-15 cm. long. Sepals acute; petals oblanceolate, obtuse. Ovary 5 celled. Fruit in drooping panicles. Drupe globose, yellow and smooth, 1.5 to 2 cm. in diameter.

Himalayas to China and Korea. China: W. Hupeh, to Yunnan and Szechuan.

Occasionally employed for medicinal uses. The stones are slightly 5 angled and are frequently made into beads and rosaries. Birds are very fond of the fruits. This tree has become naturalized in the southern portion of the U. S. of America. Extensively planted in China as a shade tree. Few species can surpass *Melia azederach* in its ornamental qualities. The foliage is graceful and feathery and is retained well on toward winter; but the tree is chiefly desirable for its flowers, which are conspicuous and produced in great profusion, of a light lavender color, with a strong lilac odor which perfumes the air for some distance. An added advantage is its very rapid growth. The wood is coarse but durable, handsomely marked, suitable for making furniture and for interior finish. In some sections of the country the tree is sometimes attacked by a borer.

CIPADESSA

Shrubs or small trees. Leaves deciduous, odd pinnate. Inflorescence paniced; flowers subglobose; calyx 5 toothed; petals 5, oblong, spreading; stamens united by their filaments into a deeply 10 lobed tube, the lobes bifid at the apex; ovary 5 celled; style short, with capitate stigma; ovules 2 in each cell. Fruit a fleshy drupe, 5 ribbed, 5 celled; cells 1-2 seeded.

1 or 2 species: Malaya, India and China.

Cipadessa baccifera Miquel.

(*C. baccifera* var. *sinensis* Rehder & Wilson)

Shrubs to small tree. Branchlets, leaves, and inflorescence pubescent or nearly glabrous. Leaves 8-25 cm. long; leaflets 7-11, opposite or subopposite, entire or coarsely serrate, short stalked; petiole 2.5-10 cm. long, pubescent. Flowers small, 4-6 mm. in diameter.

India, Malaya and China. Although specimens seen from China are more pubescent, it seems unnecessary to consider these as a variety distinct from the Indian and Malayan trees.

EUPHORBIACEAE

Herbs, shrubs, trees or rarely vines, with milky juice. Leaves usually alternate, entire or toothed, rarely compound, with stipules. Flowers small, unisexual, monoecious or dioecious; perianth simple, calyx-like, often wanting; stamens few to many, free or connate; ovary free, usually 3 celled; ovules 1, or 2, then situated side by side in each cell. Fruit usually a 3-parted capsule separating from the central column or rarely drupe-like or berry-like. Seeds albuminous.

About 250 genera and over 4,000 species in all parts of the world, but chiefly in the tropics. The family is of great economic importance. A large number of species yield substances of use in arts, industries and medicine; many have properties that are poisonous to man.

KEY TO GENERA

- A. Ovules 2 in each cell; plant without milky juice or with red juice.
 - I. Plant without milky juice; leaves alternate, simple; fruit a drupe *Daphniphyllum*.
 - II. Plant with red juice; leaves alternate, trifoliate; fruit berry-like, fleshy *Bischofia*.
- B. Ovules 1 in each cell.
 - I. Stamens incurved in the bud; disk present; plant without milky juice; fruit a capsule, obscurely 3 parted *Croton*.
 - II. Stamens erect in the bud.
 - a. Juice not milky; staminate flowers apetalous; anthers 2 celled; leaves simple *Mallotus*.
 - b. Juice milky.
 - 1. Flowers with petals; calyx valvate, leaves simple, palmately veined *Aleurites*.
 - 2. Flowers apetalous; calyx lobes imbricate; staminate calyx with connate sepals 1-3 lobed; stamens free, 2-3; seeds attached to a central column *Sapium*.

ALEURITES

Trees with milky juice. Leaves entire, or 3-5 lobed, 5-7 veined, long petioled; petioles with 2 glands at the apex. Flowers in loose cymes, usually monoecious; calyx 2-3, valvate; petals 5; stamens 8-10, the outer row attached to the base of the petals, the inner row monadelphous; ovary 2-5 celled; cells 1 ovuled; style bifid. Fruit large, drupaceous; exocarp fleshy; endocarp bony. Seeds thick shelled.

6 species, indigenous to Asia and the Pacific Islands, widely distributed and cultivated in the tropics.

Aleurites fordii Hemsley.

Tung Oil Tree.

Flat topped much branched tree, 3-8 m. tall. Bark smooth, light gray; petiole glandular; gland sessile. Leaves glossy green, entire, ovate-cordate, 7-12 cm. long, or 3 lobed and up to 20 cm. long on sterile shoots. Flowers in great profusion on wood of the previous season's growth before the leaves unfold. Flowers large, showy, white, marked with red and yellow, especially at the base of the petals. Petals orbicular ovate, about 3 cm. long, glabrous; stamens 8-10; ovary usually 4 celled. Fruit green, apple-like, subglobose and slightly pointed, smooth, 4-5 cm. in diameter. Fibrous exocarp 3.4 mm. thick. Seeds 3-5, compressed, broadly ovate, 2-2.5 cm. long, very poisonous. Wood is soft, white, of no use except, perhaps, for fuel.

Fukien, Yunnan, Hunnan, Kweichow, Hupeh, Szechuan.

Extensively cultivated. The tree yields the wood oil of commerce. It is estimated that 90% of the wood oil used in the industries, is produced by this single species. The oil is largely exported to the United States of America where it has revolutionized the varnish industry. In China it is used for water proofing cement, for illumination, and many other purposes, and it is also burned for the soot, which is an important ingredient of Chinese ink. Plantations of the wood oil tree are common in the Yangtze valley in the vicinity of Hankow. Clayey banks, rocky hillsides and other waste lands unsuited to the growing of food crops should be more generally planted to this tree. The seeds are sown in seed beds. When the seedlings attain a height of 8 or 10 inches, they are either transplanted in the nurseries or set out directly in the field.

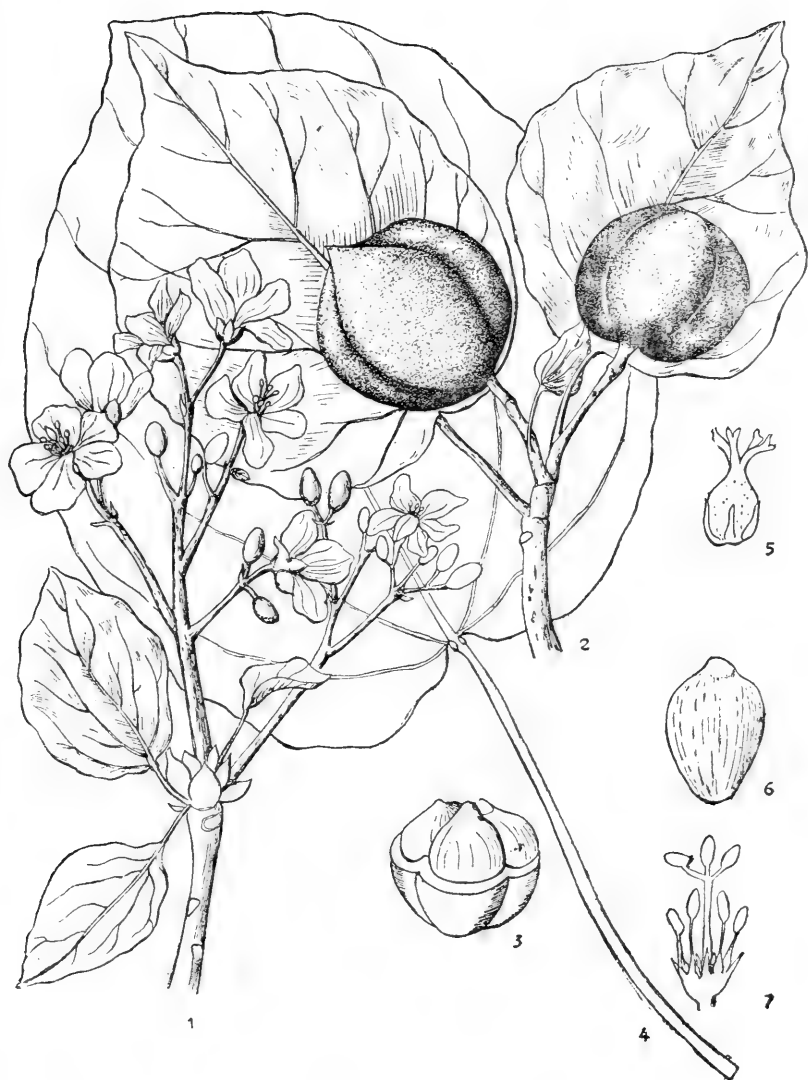


Plate 75. ALEURITES FORDII Hemsley

1. Flowering branch; 2. Fruiting branch; 3. Section of fruit; 4. Leaf; 5. Pistillate flower; 6. Seed; 7. Pistillate flower. (5 and 7 adapted from *Botanical Magazine*, slightly enlarged.)

American investigators advocate spacing the trees 20 by 20 feet apart, giving a total of 108 trees to the acre. The trees begin to produce seeds in 4 to 5 years and continue to bear effectively for 50 years or more. The average annual yield is from 30-75 lbs. per tree. The fruit is from 2-3 inches in diameter, each containing several seeds, usually 5 in number. The oil content is about 24% of the substance of the seed. The United States Department of Agriculture is endeavoring to establish the wood oil industry in America, and unless Chinese planters make a systematic effort to increase the yield and improve the quality of their product, the great American market will soon be closed to them.

***Aleurites cordata* R. Brown.**

Tree to 10 m. tall. Gland of petiole stalked. Leaves broadly ovate, acuminate, 3-5 lobed or toothed. Petals oblong, 2 cm. long, hairy at the base. Fruit rough, warty. Seeds the size of large castor beans.

S. China, cultivated in Japan. Less hardy than the preceding species.

***Aleurites montana* Wilson**, is a third species allied to *A. fordii* but differing chiefly in the fruit, which is egg-shaped, marked with 3 longitudinal and many transverse ridges. The pistillate inflorescence is racemose and the inflorescences are said to be more strictly unisexual.

S. China. Limited distribution.

MALLOTUS

Trees or shrubs. Leaves alternate or opposite, entire, serrate or lobed, often glandular. Flowers dioecious or monoecious, small, apetalous, in spikes or panicles; staminate flowers clustered; calyx 3-5 parted, valvate; stamens 20-30 or more; ovary rudimentary or absent. Pistillate flowers solitary in the bract; calyx 3-5 parted or lobed; ovary 2-4 celled; style free or partly connate, spreading or recurved, plumose or papillose; ovules 1 in each cell. Fruit capsular, separating into 2-3, 2 valved cocci. Valves smooth, warty or spiny. Seeds ovoid-oblong or globose, bony.

About 80 species in the tropics of the old world.

***Mallotus tenuifolius* Pax.**

Shrub or small tree. Leaves alternate, membranous, triangular-orbicular, abruptly acuminate, base truncate or cordate, with 2 glands

above, glandular dotted below, 12 cm. long and broad; petiole 6-10 cm. long. Inflorescence a short simple raceme. Staminate calyx 3 parted; stamens numerous, exserted. Pistillate flowers with pubescent, lanceolate sepals and pubescent ovary; style 3 parted. Capsule spiny.

Hupei and Szechuan.

Mallotus philippinensis (Lamarck) Mueller.

(*Croton philippense* Lamarck.)

Small evergreen tree. Leaves ovate to ovate-lanceolate, entire or slightly sinuate-serrate. Spikes terminal; ovary with red glands; stigma 3, sessile. Capsule not spiny, 8-12 mm. across. Seeds black.

India, China, Malay Islands to Australia.

The capsules are covered with a red powder which yields the Kamila dye used for coloring silks.

CROTON

Trees, shrubs or rarely herbs without milky juice. Leaves alternate, opposite or whorled, 2 glandular at the base. Flowers monoecious or sometimes dioecious; calyx 5 (4-6); sepals 5 (4-6), smaller or absent in the pistillate flower; disk glandular; stamens 5-many; ovary 3 (2-4) celled; style 2-4 cleft; ovules 1 in each cell. Capsule of 6 nearly equal valves, or of 3 deciduous valved cocci.

500 species or more, mostly in the tropics.

Croton tiglium Linnaeus.

Croton-oil Plant.

Small evergreen tree. Leaves 5-10 cm. long, ovate or elliptic-oblong, acuminate; petiole 2.5-5 cm. long. Pistillate flower apetalous; style 2 parted. Capsule 2-2.5 cm. long, white, obovoid, obscurely 3 parted. Seeds 1.2-2 cm. long.

S. E. Asia.

Commonly cultivated in parts of Szechuan where the leaves are mostly retained through the winter and become highly colored before falling in the spring (Wilson).

Croton oil, a powerful purgative, is extracted from the seeds. Colloquially known as the Pa-tou tree (Wilson).

BISCHOFIA

Trees. Leaves alternate, trifoliate. Flowers small, paniculate, dioecious, apetalous, inconspicuous; staminate with 5 sepals and included stamens; pistillate flowers with 5 ovate, caducous sepals, 5 staminodes, and a 3-4 celled exserted ovary; style linear, entire; ovules 2 in each cell. Fruit globose, fleshy, 3-4 celled; seeds oblong.

Ornamental tropical trees.

Bischofia javanica Blume.

Glabrous tree up to 25 m. tall with smooth or fissured gray bark, and very variable trifoliate leaves; leaflets ovate to ovate-lanceolate, acuminate, crenate-serrate, 8-13 cm. long. Flowers greenish in many-flowered panicles. Fruit blue-black, fleshy, berry-like, on a thick pedicel, about the size of a pea. Seeds dark shiny brown with papery testa splitting longitudinally.

Szechuan and Hupeh.

A rare tree. The wood is of no great commercial importance. The foliage is bronze green, and is very ornamental.

SAPIUM

Glabrous trees or shrubs with milky, poisonous juice. Leaves alternate, stalked, entire, seldom toothed. Petioles with 2 glands at the base of the leaf; the scale-like bracts also glandular. Flowers without petals, in terminal spikes; the staminate in 3's; the pistillate flower single, clustered at the base of the inflorescence. Calyx of staminate flower 2-3 lobed. Ovary 1-3 celled, 1 ovule in each cell.

Important economic plants, nearly 100 species known in the tropics of both hemispheres.

The genus is characterized by apetalous flowers on a spike, each flower with 2 free stamens, and by a capsular fruit opening loculicidally but retaining the seeds which are attached for a long time to the more or less 3 angled central column. Propagated by seeds, layers and cuttings.

Sapium sebiferum Roxburgh.

(*Stillingia sebifera* Michaux.)

Tallow tree.

Small to medium sized tree up to 15 m. high. Leaves long stalked, rhombic-ovate, often broader than long, wedge-shaped at the base, acute

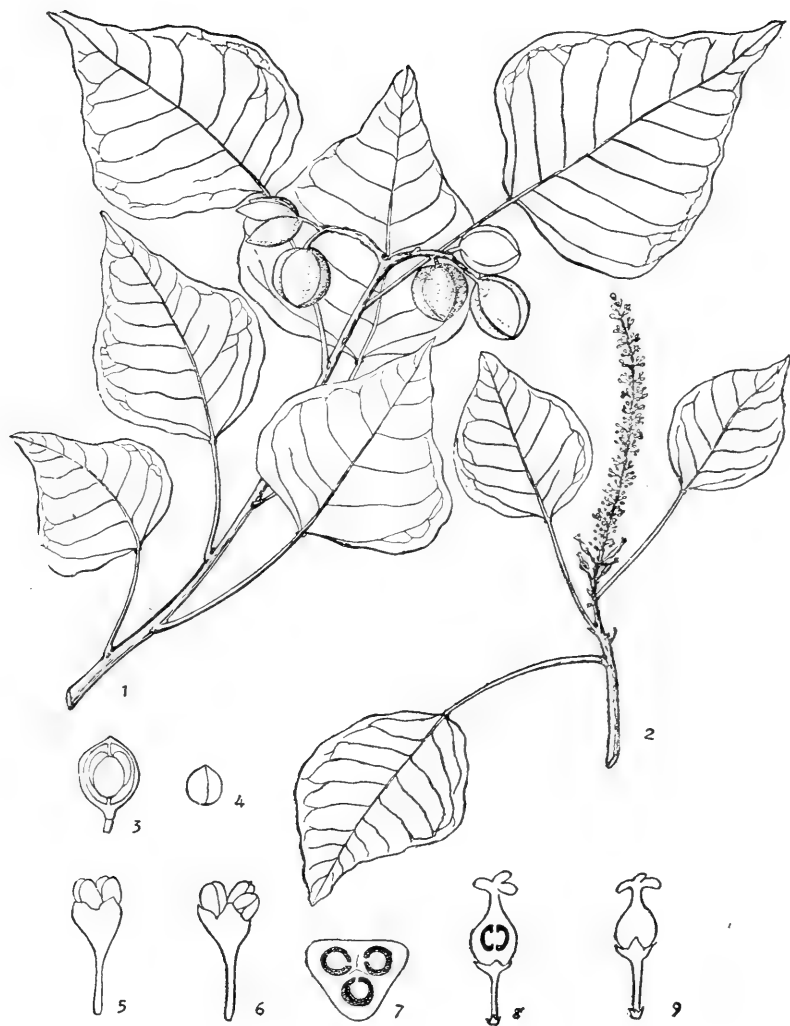


Plate 76. *SAPIUM SEBIFERUM* Roxburgh

1. Fruiting branch; 2. Flowering branch; 3. Section of fruit; 4. Seed; 5, 6. Staminate flower; 7. Section of ovary; 8. Pistillate flower sectioned; 9. Pistillate flower (Details enlarged.)

at the apex, green and turning into a brilliant red in the autumn. Capsule 12 mm. long, 15 mm. broad, globose elliptical, blackish-brown when ripe, 3 celled, each containing 1 seed which adheres for some time to the central column of the capsule. Seeds black, covered with a white coating of a waxy substance.

Kiangsu, Chekiang, Fukien, Hupeh, Szechuan, Kwangtung, Hainan, Formosa, Hongkong and Japan.

Sapium sebiferum is the source of the vegetable tallow extensively used for the manufacture of candles. In the autumn the fruits are dried in the sun in order to release the seeds, which are coated with a fatty substance. The seeds are steamed and rubbed through a sieve to separate the wax, which is then melted and allowed to harden in molds. This is the pure tallow, Pe Yu. It is hard, tasteless and colorless, with a melting point of 70 deg. C. (164 deg. F.) This tallow is made into candles particularly for the services of the temples, because they burn with a clear, odorless flame. It is also used to impart gloss to cloth and for sizing paper. The cleaned seeds with the coating of tallow removed, are then lightly bruised in mill stones, roasted, and pressed for the oil which they contain, which is the Ting Yu of commerce. The yield is about 50% by weight of the dry seeds. The oil is strongly odorous, yellowish in color, with a drying property which is used for waterproofing hats and umbrellas. It makes a fairly good illuminant. The third product obtained from the tallow tree is the Mo Yu, a mixture of the fatty wax and the oil from the kernels, derived by simultaneous extraction. The leaves of *Sapium sebiferum* yield a black dye used in dyeing cotton black. The wood is white and fairly hard, used for a variety of purposes, among them the making of printing blocks. Ting Yu is sometimes used in medicine for its purgative properties. The leaves of this species are brilliantly colored in the autumn.

DAPHNIPHYLLUM

Evergreen shrubs or trees. Leaves alternate, entire, pinnately veined, large, coriaceous, glaucous below, without stipules. Flowers dioecious, apetalous, in axillary racemes. Calyx 3-8 parted; stamens 5-18; ovary imperfectly 2 celled; ovules 2 in each cell. Fruit a small olive-like drupe usually 1 seeded.

About 11 or 12 species in tropical Asia, of which 3 occur in China. The following is the only one attaining tree size.

Daphniphyllum macropodum Miquel.

A glabrous shrub or small tree, 8-10 m. tall. Branchlets red. Leaves oblong, about 22 cm. long and 5 cm. wide, bluish on the under surface; petiole red, 2.5-5 cm. long. Fruit black, 12 mm. long.

Central China and Japan.

ANACARDIACEAE

Trees or shrubs with resinous or milky sap. Leaves alternate, simple, trifoliate or pinnate, without stipules. Flowers regular, perfect or unisexual, sometimes polygamous, small and numerous. Calyx 5 cleft; petals 3-5, alternate with the sepals or absent; stamens as many as or twice as many as the petals, rarely more, inserted with the petals at the base of the disk. Ovary 1, rarely 2-6 celled; ovules 1 in each cell. Fruit a drupe or nut, rarely dehiscent. Seeds exalbuminous.

About 50 genera and 400 species, mostly in the tropics of both hemispheres. *Rhus*, the largest genus, reaches farthest north. *Mango*, *Cashew*, *Anacardium* and *Pistacia* are important tropical or subtropical genera.

KEY TO GENERA

- I. Ovary 1 celled; fruits small; compressed, composed of 1 seeded drupe.
 - A. Flowers apetalous.....*Pistacia*.
 - B. Flowers with petals.....*Rhus*.
- II. Ovary 2-5 celled, fruit a large ovoid drupe, the stone several celled.....*Spondias*.

SPONDIAS

Trees. Leaves deciduous, alternate, odd pinnate, with opposite, stalked leaflets. Flowers polygamous, in racemes or panicles; calyx 4-5, small, deciduous; petals 4 or 5; stamens 8-10; styles 3-5; ovary sessile, 3-5 celled; ovules solitary in each cell. Fruit a drupe with fleshy exocarp and a hard, bony endocarp, 1-5 celled.

About 12 species of subtropical plants in the West Indies, tropical America, India and China. The branches root readily when cut off and inserted in the ground; for this reason, *Spondias* is especially useful as windbreaks and hedges and for holding sandy banks.

Spondias axillaris Roxburgh.

Tree 25 m. tall. Leaves deciduous, alternate, odd pinnate; leaflets 9-13, opposite, lanceolate, or ovate-lanceolate, acuminate, oblique at the base, entire; petiolules short. Flowers polygamo-dioecious; staminate and pistillate, small, borne in many flowered, axillary panicles. Perfect flowers larger than the unisexual flowers (7 mm. across) 1-3 (commonly solitary) on short peduncles in an axillary raceme. Stamens 10; styles 5, short, erect; ovary 5 celled. Fruit a drupe, yellow when ripe, flesh edible. Stone hard, ovate to obovoid, with 4 scars near the apex, 5 celled.

A common tree in the valleys of western Hupeh and Szechuan. Yunnan and Hongkong to Hainan.

Var. *pubinervis* Rehder and Wilson, supposed to be distinct by its pubescent or villose leafstalks and leaflets, shows many gradations towards the typical form, so that it can hardly be differentiated by the practical botanist or forester. The fruits, known as Hsuan Tso, are edible.

PISTACIA

Trees or shrubs. Leaves evergreen or deciduous, alternate, trifoliate or pinnate, without stipules; leaflets entire. Flowers small, dioecious, apetalous, in axillary panicles or racemes, subtended by bracteoles. Staminate flowers with 1-5 (mostly 5) parted or cleft calyx; stamens 3-5 with a small disk. Pistillate flowers with a 2-5 parted calyx and sessile ovary; style 3 lobed; ovary 1 celled. Fruit a drupe with a bony endocarp and more or less fleshy cotyledons.

Nine species in the Mediterranean regions, China and Mexico.

Pistacia chinensis Bunge.

Tree 18 m. tall. Leaves deciduous, alternate, odd pinnate; leaflets 11-13, lanceolate or ovate-lanceolate, entire, acuminate, about 8 cm. long and 2 cm. wide, oblique at the base and short petiolate. Staminate flowers in crowded racemes, 10-18 cm. long; pistillate flowers in branched panicles, 18-22 cm. long. Fruit obovoid-globose, compressed, drupe-like, about 6 mm. in diameter, scarlet at first, later turning purplish or blue.

Central China.

The foliage of this tree turns scarlet and orange in the autumn. The young shoots and leaves are eaten as a vegetable. The wood is close



Plate 77. *SPONDIAS AXILLARIS* Roxburgh

1. Fructing branch; 2. Flowering branch; 3. Pseudo-hermaphrodite flower cluster; 4. Seed; 5. Staminate flower; 6. Pistillate flower; 7. Pseudo-hermaphrodite flower. (5, 6, 7 enlarged, adapted.)



Plate 78. *PISTACIA CHINENSIS* Bunge

1. Fruiting branch; 2. Flowering branch; 3. Pistillate branch; 4. Buds; 5. Pistillate flower; 6. Staminate flower; 7. Section of pistillate flower.

grained and tough, used in boat building and general carpentry. On account of its hardness, nurserymen use this tree as stock upon which *Pistacio vera*, which produces the pistacio nuts of commerce, is grafted. By resorting to this practice the Italian pistacio nuts might well be grown for the market in China. The nuts are eaten roasted, and are otherwise employed in confectionary.

RHUS

Trees or shrubs with milky juice. Leaves deciduous or evergreen, alternate, simple, trifoliate or odd pinnate, without stipules. Flowers small, dioecious or polygamous, white or greenish, in axillary or terminal panicles. Calyx 4-6 parted or cleft, generally 5 parted, persistent, imbricated; petals 5, deciduous, imbricated; stamens 5, inserted below the fleshy disk. Ovary solitary, sessile, superior; styles 3. Fruit a small, dry, 1-seeded drupe; endocarp smooth or pubescent, coriaceous or bony.

About 125 species in the tropical and temperate regions of both hemispheres, about 10 species in China. The genus is composed of shrubs or small trees usually characterized by compound leaves turning a brilliant red or orange in the autumn and by inconspicuous flowers in large terminal panicles followed by numerous small fruits which are sometimes handsomely colored. Several species possess useful properties of commercial importance. The foliage and bark of nearly every species contain tannin, which may be used for tanning hides. *Rhus verniciflua* yields the lacquer used for lacquer ware; from *Rhus succedanea* vegetable wax is obtained for the manufacture of candles. Chinese Gall, exported to Europe in large quantities for the manufacture of tannic acid, is produced on the branches and leaf stalks of *Rhus javanica* through the action of an insect. *R. verniciflua* and *R. succedanea* have a poisonous property extremely toxic to some people when the plants or parts of them are handled. The poison (toxicodendrol) is contained in a heavy non-volatile oil, very minute quantities of which may cause eruptions on the skin. This poisonous oil may be removed by several thorough washings with soap and water.

Rhus verniciflua Stokes.

(*R. vernicifera* De Candole.)

Lacquer Varnish Tree. Che Shu.

Tree to 20 m. tall with pale gray, smooth bark when young and dark gray, furrowed bark at maturity. Leaves odd pinnate, 25-75 cm. in length;



Plate 79. RHUS VERNICIFLUA Stokes

1. Flowering branch; 2. Fruiting branch; 3, 4. Flowers; 5. Stamen.
(Details enlarged.)

leaflets usually 11-15, ovate-oblong, pointed, rounded or broadly cuneate at the base, entire, short stalked, more or less densely pubescent when young, 8-15 cm. long. Flowers small, yellowish-white, in loose panicles from the axils of the leaves near the ends of the shoots, about 25 cm. long or longer. Fruit about 6 mm. wide (5-8 mm.), smooth, numerous, shiny yellow.

Wild in the mountains of Szechuan and Hupeh, also very extensively planted. This is a handsome tree, sometimes reaching 100 feet high, with graceful foliage turning into red and orange in the autumn. The sap wood is white, the heart wood yellow; the wood is only good for fuel. The seeds are expressed for the oil, which is used as an illuminant and to adulterate Tung Oil. The tree, however, is chiefly noted for the lacquer varnish which it yields, and it is planted throughout Central China for this valuable product. The varnish is obtained by incisions on the trunk; the syrupy substance flowing from the wound is collected in bamboo or other receptacles. As it flows from the tree, the sap is white, but it soon changes to greenish-gray, and finally black if not protected from exposure to the air. Tapping may begin when the tree is 5 or 6 years old, and continues at definite intervals, alternating with periods of rest, until it is 50 or 60 years old. Another method is to make numerous incisions on the trunk and branches of young trees, about 10 years of age, and collect the sap so long as it continues to flow, then the main branches are cut off and steamed to extract whatever sap they may still contain, but this process kills the tree in one season. *Rhus verniciflua* may be propagated by seeds and by cuttings. The seeds are deprived of their covering by pounding in a mortar, then they are put in straw bags and left to soak in water or liquid manure throughout the winter. After thorough drying, they are sown in seed beds in the following spring. Root cuttings make more rapid growth but produce slightly less vigorous and short-lived trees. Roots about 1/2 inch in diameter taken from young trees are cut into 6 inch lengths, planted in a slanting position with 1 to 2 inches projecting above ground in prepared beds in early spring. In one year they produce shoots about 2 feet long.

Rhus verniciflua will grow on rocky soil and barren slopes.

***Rhus succedanea* Linnæus.**

Wax Tree.

Shrub or small tree to 10 m. high, with irregularly fissured, thin gray bark. Leaflets 7-15, elliptic-oblong to lanceolate, acuminate, cuneate,

entire, glossy green above, pale and glabrous below, 5-10 cm. long. Flowers yellow-green. Fruit yellowish-white, compressed, to 8 mm. broad.

Yunnan, Hupeh, Szechuan, Hongkong, Formosa. The seeds are covered with a fatty substance which is expressed for various uses, in Japan particularly for the manufacture of candles. The seeds are ground, steamed and pressed, and the fatty content refined by melting. This rhus tallow, not really a wax, is exported from Japan in great quantities into Europe and America, where it is used either to adulterate beeswax or to be used in its stead.

Rhus javanica Linnæus.

(*R. semialata* Murray.)

Nut Gall Tree. Fu Yung Shu.

Shrub or small tree up to 8 m. high. Leaflets 7-13, nearly sessile or short stalked, ovate to ovate-oblong, acute, rounded or broadly cuneate at the base, crenate serrate, brownish pubescent beneath, 5-15 cm. long, rachis often winged. Panicles 20-25 cm. long; flowers creamy white. Fruit small, subglobose, orange red, pubescent.

Himalayas to China and Korea.

This *Rhus* is the host of the insect which produces the Nut Gall of commerce. The galls are irregular in shape, light and hollow, ranging from 1 to 4 inches long. The acid content is about 70% of the substance of the gall. Quantities of these galls were formerly used in Germany for the production of tannic and gallic acids. In China the galls are used to dye blue cloths and silks black.

AQUIFOLIACEAE

Trees or shrubs. Leaves evergreen or deciduous, alternate or opposite, simple. Flowers perfect, rarely unisexual, axillary, small, solitary or clustered; sepals 2-6, more or less connate; petals and stamens 4-5; ovary superior, 3-many celled; ovules 1-2 in each cell. Fruit berry-like.

Three genera and about 280 species. The genus *Ilex* embraces 275 of the total 280 species.

ILEX

Shrubs or trees with evergreen, deciduous, alternate, simple, and sometimes spiny leaves. Flowers dioecious; calyx lobes, petals and stamens usually 4 (5); ovary superior, 2-13 celled; style short or absent. Fruit a berry-like, globose or ovoid drupe, with 2-16, bony, 1 seeded stones.

About 275 species, mostly in N. & S. America and temperate and tropical Asia, 20 or 25 species are found in China, mostly shrubs. In North America and England, several species with deep green, shiny leaves and scarlet berries are used for Christmas decorations. The wood is light, close-grained, soft but tough, and is greatly esteemed for engraving and furniture making. The Hollies are slow growing and are important from the ornamental standpoint only.

***Ilex pernyi* Franchet.**

Shrub or small tree. Branchlets pubescent. Leaves evergreen, rhombic-ovate or quadrangular-ovate, dark shiny green, with 1-3 pairs of rigid spines, 2-2.5 cm. long, short petioled. Flowers numerous, sessile. Fruit light red, globose, ovoid, 8 mm. across.

Central China. A handsome evergreen.

STAPHYLEACEAE

Trees or shrubs. Leaves opposite or rarely alternate, odd pinnate, with stipules. Flowers perfect, regular, racemed or panicled; sepals, petals, and stamens 5; disk cup shaped; ovary usually 3 celled; styles 3, free or connate. Fruit a more or less lobed capsule, or a berry, or drupe-like.

About 6 genera and 22 species in the north temperate regions. The family is of no economic importance.

KEY TO GENERA

- I. Leaves opposite, seeds several in each cell; fruits an inflated bladderly capsule *Staphylea*.
- II. Leaves alternate; seeds 1 in each cell; fruit berry-like.. *Tapiscia*.

STAPHYLEA

Deciduous shrubs or trees with opposite leaves. Leaflets 3-7, serrulate and stipulate. Flowers perfect, regular, white or pink, in terminal panicles or racemes; carpels 2 or 3, more or less united at the base. Fruit a membranous, inflated, pale green, 2 or 3 celled capsule. Seeds globose, bony, 1 or several in each cell.

12 species in the temperate regions of the northern hemisphere. 2 species in China. The bladdery fruits are conspicuous.

Staphylea holocarpa Hemsley.

Bladder-nuts.

Shrub or tree, 8-10 m. tall. Leaves trifoliate; leaflets oval to ovate-lanceolate, acuminate, finely serrate, 5-10 cm. long; lateral leaflets nearly sessile. Flowers before the leaves in drooping panicles, 4-10 cm. long, white or pink. Capsule inflated, pear shaped, abruptly acuminate, 4-5 cm. long. Seeds gray-brown.

Hupei, Szechuan, Shensi.

S. bumalda De Candolle is a shrub, with very showy flowers.

China and Japan.

TAPISCIA

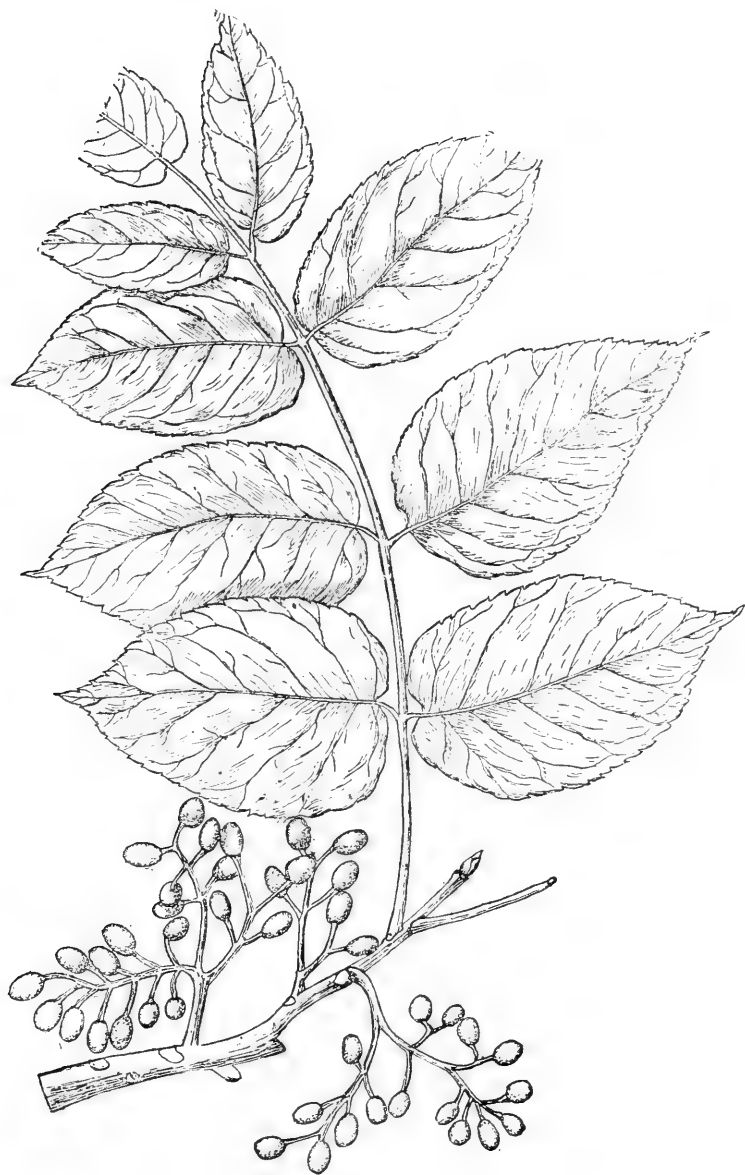
Deciduous trees. Leaves alternate, odd pinnate, stipulate. Flowers in axillary panicles, regular, perfect; calyx tubular, 5 lobed; petals 5, oblanceolate; stamens 5, alternate with the petals, exserted; ovary 1 celled, 1 ovuled; style 1. Fruit ovoid, indehiscent, with bony endocarp.

A monotypic genus confined to China, strongly resembling *Pistacia* but not at all related to it. The generic name is an anagram of *Pistacia*.

Tapiscia sinensis Oliver.

Tree 10-15 m. tall, rarely 30 m. tall with light gray, shallowly fissured bark. Leaves 30-45 cm. long; leaflets 5-7, ovate-elliptic, acute or acuminate, cordate or rounded at the base, gray-green beneath, 8-13 cm. long. Flowers and fruits borne in drooping panicles. Flowers minute, yellow, fragrant. Fruit ovoid, black, about 12 mm. long.

Szechuan and Hupei.



TAPISCIA SINENSIS Oliver

The wood is soft and light. Useful as an ornamental tree on account of its large attractive foliage and paniced fragrant yellow flowers.

ACERACEAE

Leaves opposite, simple, usually, but not always, palmately lobed, rarely entire, or pinnately compound, without stipules. Flowers dioecious or monoecious, perfect or polygamous, regular. Stamens 4-10, usually 8. Ovary superior, 2 celled. Style 1. Stigma 2. Fruit, 2 long-winged samaras joined at the base where the seeds are borne; seeds 1 or 2 in each cell, exalbuminous; the cotyledons thin and folded.

A family of 2 genera, one widely distributed throughout the northern hemisphere, the other monotypic and confined to China. The samaroid fruit and opposite, exstipulate leaves are characteristic of this family.

KEY TO GENERA

- I. Nutlets encircled by a broad wing; leaves pinnate, with 9-15 leaflets *Dipteronia*.
- II. Nutlets with an elongated wing on one side, in pairs; leaves simple or compound *Acer*.

ACER

Trees or shrubs with watery, often saccharine sap. Leaves mostly deciduous, opposite, petiolate, simple, lobed or compound, with 3 to 5 leaflets. Inflorescence in racemes, fascicles or corymbs. Flowers dioeciously or monoeciously polygamous, regular, small; calyx colored, 5 parted; petals 5 or absent; stamens usually 8 (4-10); styles 2; ovary 2 lobed, 2 celled, and with 2 ovules in each cell. Fruit 2 long winged samaras united at the base where the seeds are borne. Seeds solitary by abortion, rarely 2.

About 100 species in Asia, Europe, N. America and Northern Africa. Sixty or seventy species have been found in eastern Asia. Of these a large number occur in China. The Maples are ornamental shrubs and trees with handsome foliage turning to brilliant colors in the autumn. Several species are valuable timber trees. One American species, *Acer*

saccharum, besides being a valuable timber tree, yields a richly saccharine sap which is made into sugar. Few trees surpass the maples for street and lawn planting.

The wood of several American species is valued in wood-using industries. The maples in this country do not attain the size or importance that they do in North America, where several species are important constituents of the forests.

***Acer henryi* Pax.**

Tree 10 m. tall. Young branchlets pilose. Leaf compound; petiole 6-7 cm. long, pubescent; leaflets 3, 5-9 cm. long, elliptic, acuminate, stalked, entire or coarsely toothed, pale green, pubescent beneath. Flowers in pubescent racemes, nearly sessile, small, greenish. Fruits in pendulous racemes, glabrous, short pedicelled, wings ascending or spreading, 1-2 cm. long.

Central China.

***Acer pictum* var. *parviflorum* Schneider.**

Tree 18 m. tall. Branchlets gray or gray-brown, with numerous conspicuous lenticels. Leaves bright green, 3-7 lobed, about 10 cm. long, base rounded, truncate or cordate, pubescent beneath when young. Flowers yellow. Wings of fruit horizontal or spreading, brownish-yellow, slightly less than 2 times as long as the nutlet.

Western and Central China. Yunnan, Szechuan, Hupeh, Chihli, Manchuria and Japan.

The type is said not to occur in China.

***Acer cappadocicum* Gleditsch.**

(*A. laetum* C. A. Meyer.)

Tree to 16 m. tall, with smooth greenish or greenish-purple bark on the branchlets. Otherwise the tree is very similar to the above species.

Further study may prove this species to be identical with *Acer pictum*. Several varieties have been described.

From Caucasus to the Himalayas and Western China.



Plate 81. ACER HENRYI Pax

1. Fruiting branch; 2. Leaf; 3. Fruit.



Plate 82. *ACER PICTUM* var *PARVIFLORUM* Schneider

Acer oblongum Wallich.

Tree 18 m. tall. Leaves oblong, entire, sometimes 3 lobed in young plants, long acuminate at the apex, 3 nerved at the base, 4-18 cm. long, glaucous below. Wings of samara at right angles or spreading.

Western and Central China to the Himalayas.

Acer palmatum Thunberg.

Shrub or small tree. Leaflets 5-7 lobed, 6-8 cm. long, oblong-ovate, acuminate, doubly serrate. Wings and seeds about 2 cm. long.

Kiangsi.

Acer davidii Franchet.

Tree 15 m. tall. Branchlets glabrous. Leaves ovate, or oblong-ovate, 6-22 cm. long, acuminate, crenate-serrate, rounded or subcordate at the base. Fruit in slender racemes, wings horizontal.

Central China.

Acer trifidum Hooker & Arnot.

Small tree with leathery 3-lobed leaves. Commonly planted as hedges. China and Japan.

DIPTERONIA

The genus differs from *Acer* by the wings of the fruit entirely encircling the nutlet. It is represented by a single species, confined to Hupeh and Szechuan.

Dipteronia sinensis Oliver.

Tree 6 m. high. Leaves odd pinnate, 22-45 cm. long; leaflets 9-15, 2.5-5 cm. long, acute, coarsely serrate. Flowers profuse, in terminal panicles. Fruit ovate, compressed, oblique.

HIPPOCASTANACEAE

Trees or shrubs. Leaves palmately 3-9 foliate. Flowers perfect, or unisexual, irregular. Sepals 5. Petals 4-5, unequal, guiculate. Stamens free, 5-8, disk extra-staminal. Ovary 3 celled. 2 ovules in each cell. Style 1. Stigma 1. Fruit usually a 3 valved capsule, 1 celled, 1 seeded. Seeds very large, exalbuminous.

A family containing 2 genera, 1 widely distributed in the temperate regions of the world, the other (*Billia*) confined to Mexico and Central



Plate 83. ACER OBLONGUM Wallich

1. Fruiting branch; 2. Leaf showing variation from normal.

America. This family is often united with *Sapindaceae* to which it is closely related by the presence of the extra-staminal disk, a feature in common shared by only 1 other family, namely *Melanthaceae*, and several species of *Acer*.

ÆSCULUS

Trees or shrubs. Winter buds large, with large bud scales. Twigs with conspicuous triangular scars. Leaves deciduous, opposite, digitately compound, with long petioles, without stipules. Leaflets, 5-9, serrate, palmately veined. Flowers in large terminal panicles or racemes, polygamous and symmetrical; the perfect flowers usually near the base of the inflorescence; calyx campanulate, unequally 4-5 toothed; petals 4-5, with long claws, alternate with the calyx; stamens 5-9, usually 7; ovary 3 celled, ovules 2 in each cell; style slender, elongated. Fruit a large leathery capsule, 3 celled, 3 seeded (usually 1 or 2), and 3 valved. Seeds large, coriaceous, brown and shining, with a large scar at the base, exalbuminous.

About 20 species in E. Asia, N. America and the Himalayas.

The genus is distinguished by large winter buds covered by several pairs of outer scales, palmately compound leaves, and white, red or yellow flowers in conspicuous terminal panicles, and large, shiny chestnut-like seeds. Several species are planted as ornamental and shade trees. The large seeds of *Æsculus* are rich in starch and may be used as food for sheep and swine. The roots contain saponin suitable for cleansing purposes. The wood is of little value, being soft and not durable, although sometimes employed for the manufacture of small articles. It has been found useful for paper making.

Æsculus chinensis Bunge.

Tree 20 m. tall. Leaflets 5-7, large, 10-18 cm. long, obovate-oblong, acuminate, rounded to cuneate at the base, finely serrate, short petioluled, shining green above, glabrous below, except along the veins which are more or less hairy; petiolules pubescent. Flowers in elongated, cylindrical, upright panicles, 25 cm. long. Flowers small, usually less than 12 mm. long, unequally 5 lobed, pubescent; petals 4, 10 mm. long. Fruit subglobose, depressed at the apex, 3-4 cm. in diameter, shell hard and warty, 1 celled and 3 valved. Seeds 2-2.5 cm. in diameter, chestnut-brown; basal scar or hilum large, extending over 1/2 of the base.

Shensi, and mountains west of Peking in Chihli.

The seeds of this Horse-Chestnut are used in the treatment of rheumatism.

***Æsculus wilsonii* Rehder.**

Tree 25 m. tall. Leaflets 5-7, 10-22 cm. long, densely pubescent beneath when young. Panicles erect, 15-30 cm. long. Flowers large, 12 mm. long, upper petals marked by a yellow spot. Fruit ovoid, slightly pointed, shell thin. Seeds large, 4 cm. across, basal scar less than $\frac{1}{3}$ of the base.

Western and Central China.

SAPINDACEAE

Leaves usually alternate and compound. Flowers unisexual, or polygamo-dioecious, regular or obliquely unsymmetrical, small. Sepals 5. Petals 4 or 5, or absent, generally with scales or tufts of hairs on the inner base. Disk fleshy, entire or lobed. Stamens hypogynous, usually 10, filaments generally hairy, and more or less connate at the base in 2 series. Ovary superior, generally 3 celled and deeply 3 lobed; ovules 1 in each cell. Style 1. Fruit a fleshy or leathery capsule, a berry, a nut, or a winged fruit.

About 118 genera and approximately 1,000 species, mostly of tropical and subtropical distribution. An important family on account of the large number of species yielding either edible fruits or dyes, or soaps and oils.

KEY TO GENERA

- I. Flowers irregular; fruit an inflated, bladder-like capsule.....*Koeleruteria*.
- II. Flowers regular.
 - A. Fruits edible with fleshy aril free from the seed.
 1. Flowers with petals; calyx deeply 5 parted, imbricate; fruit (in our species) yellow-green, smooth.....*Euphoria*.
 2. Flowers without petals; calyx lobes valvate, small or obscure; fruits tuberculate, purplish red.....*Litchi*.



Plate 84. *AESCULUS WILSONII* Rehder

1. Flowering branch; 2. Bud; 3. Section of flower; 4. Fruit.

B. Aril wanting.

1. Fruit globose composed of 1-3 carpels, the abortive carpels persisting under the fruit*Sapindus*.

SAPINDUS

Trees or shrubs or rarely climbers. Leaves alternate, without stipules, abruptly pinnate, or rarely simple. Leaflets mostly entire, rarely serrate. Flowers minute in panicles or racemes, polygamo-dioecious. Sepals 5. Petals 5 or more, often appendaged on the inner surface near the base with a glabrous or hairy scale. Stamens 8 or 10, filaments usually hairy. Ovary sessile, 2-4, commonly 3-lobed, usually 3-celled (2-4); style usually 3-lobed. Ovules 1 in each cell. Fruit globose, coriaceous or fleshy, composed of 1-3 carpels, the rudimentary carpels persisting at the base of the fruit. Seeds globose, bony, black.

Distributed throughout the tropics of Asia and America. About 40 species have been described. *Sapindus* is characterized by large pinnate leaves, small white flowers in large terminal panicles, and by rounded, red-brown to black, berry-like fruits. They may be planted on dry and rocky situations in all sub-tropical regions. Propagated by seeds.

***Sapindus mukorossi* Gaertner.**

Wu-huan Shu.

Tree 18 m. tall. Leaflets usually alternate, bright green, short stalked, ovate-lanceolate, obliquely cuneate at the base, entire, glabrous, reticulate veined, 8-15 cm. long, the terminal pair smaller. Flowers small, usually bisexual, in terminal panicles, 12-20 cm. long. Sepals 5, obtuse. Petals mostly 4, white or purplish, with ciliate margins, ovate to ovate-lanceolate, acute, with tufted hairs and 2 scales on the inside. Stamens 8, filaments villose, exserted. Fruit a fleshy drupe, single or in pairs, glabrous, yellow or orange, keeled, about 2 cm. in diameter. Seeds globose, black, hard, and bony.

Himalayas, India, China, Korea.

Cultivated in Japan.

The fruit is saponaceous and is used as a substitute for soap, for which purpose it is considered more desirable than the pods of *Gleditsia*.



Plate 85. *SAPINDUS MUKOROSSI* Gaertner

1. Flowering branch ; 2. Fruiting branch ; 3. Seed ; 4. Section of staminate flower ; 5. Section of pistillate flower ; 6. Stamen.

The saponin is contained in the inner surface of the seed covering. The seeds are round and black. They are often strung into necklaces and rosaries. The soft, yellow-white wood is manufactured into small articles, notably combs.

EUPHORIA

Deciduous trees. Leaves pinnate. Flowers regular; calyx 5 parted; petals spatulate or lanceolate; stamens usually 8 (6-8); stigma 2. Fruit globose, ellipsoid, with a more or less warty coat.

Euphoria longana Lamarck.

(*Nephelium longana* (Lam.) Gambessedes.)

Tree 8-12 m. tall. Leaflets 2-5 pairs, opposite or alternate, elliptic to ovate or lanceolate, entire, subcoriaceous, pale green, to 30 cm. long. Inflorescence in large terminal or axillary panicles; flowers small, fragrant, yellow, pubescent; calyx deeply 5 parted; petals 5, spatulate; disk large, lobed; stamens 8; stigma and ovary lobed. Fruit globose, with a slightly warty, brown coat later becoming smooth, containing a white, fleshy, edible aril surrounding a large, dark brown seed.

Central and Southern China.

This tree produces the well known Long-an fruits. Extensively cultivated.

Litchi is distinguished from *Euphoria* chiefly by its fruits which have a thin red coat covered with warty protuberances. *Litchi* and *Euphoria* have been placed by some botanists under *Nephelium* from which both differ by having the arillus or fleshy pulp free from the seed. Only 1 species of *Litchi* is known.

Litchi chinensis Sonnerat (1806).

(*Litchi lichi* Linn.) (Lour.) (Britton.)

(*Dimocarpus lichi* Loureiro) (1790.)

(*Euphoria sinensis* Linnæus) (1791.)

Widely cultivated in Southern China, and truly wild in the Island of Hainan. The wood is reddish, extremely hard, close grained, heavy, strong, and durable, much used by the aborigines of Hainan for the making of mortars and pestles with which the rice is hulled.

This tree produces the most important of all the fruits in Southern China.

KOELREUTERIA

Deciduous trees, winter buds with 2 bud scales. Branchlets with many lenticels. Leaves alternate, pinnate or bipinnate with lobed or serrate leaflets. Flowers in large terminal panicles, polygamous, yellow, irregular; calyx unequally 5 lobed; petals 5 (4), lanceolate, clawed; disk oblique, 3-5 lobed at the apex; stamens 8 (5-8), exserted, declinate; ovary superior, 3 angled with elongated style and 3 parted stigma. Ovary 3 celled, 2 ovules in each cell. Fruit an inflated, bladder-like capsule with thin papery walls, opening into 3 valves; seeds usually 1 in each cell, round and black.

About 5 species in China and Japan. Medium sized trees, characterized by compound leaves, yellow flowers in large, showy panicles followed by inflated, bladder-like fruits. Propagated by seeds. Chiefly ornamental.

Koelreuteria paniculata Laxmann.

Tree 18 m. tall. Leaves odd pinnate, 5-13 cm. long; leaflets 9-13, opposite or subopposite, nearly sessile, ovate, toothed or more or less lobed at the base, glabrous, 4-7.5 cm. long, 3 cm. wide; valves ovate, acuminate. Seeds 6 mm. in diameter.

Chihli, Kansu, Shensi, Szechuan, Kiangsu, and Chekiang. Common in the hills around Peking. In classical times this tree was known as the "Lan," a tree especially designated to mark the tomb of feudal princes. The flower is used in medicine. It is also used as a yellow dye. The black, pea-like seeds are strung into necklaces.

Koelreuteria apiculata Rehder and Wilson, cannot be regarded as distinct from *K. paniculata*.

Koelreuteria bipinnata Franchet.

Tree to 15, sometimes 25 m. tall. Leaflets 9-13, ovate-oblong, more or less evenly serrate, pubescent along the midrib and veins below, 4-10 cm. long. Capsule ovoid, rounded at the apex, about 6 cm. long.

Mountains of Central and South-western China. Yunnan, Hupeh, Chekiang.

RHAMNACEAE

Trees or shrubs, rarely herbs, sometimes climbing and spiny. Leaves simple, alternate, rarely opposite. Flowers perfect or polygamous, regular, perigynous, small, greenish or yellow, mostly in cymes. Sepals 5, rarely 4; petals 5 (4) alternate with the sepals; stamens opposite, and the same number as the petals. Disk lining the calyx tube. Ovary superior or inferior, 2-4 celled, usually 1 ovule in each cell; styles 2-4, more or less connate. Fruit a drupe or a capsule or a winged nut.

About 46 genera and 350 species widely distributed throughout the world. The simple, 3 nerved leaves, perigynous flowers with the stamens opposite the petals, are characteristic of this family. The genera treated in this work are the only arborescent ones in China.

KEY TO GENERA

- I. Leaves pinnately veined; ovary superior, 3-4 celled; style 3-4 cleft; fruit a drupe, free from the calyx, enclosing 3-4 stones.. *Rhamnus*.
- II. Leaves 3 nerved at the base.
 - A. Ovary free from the disk lining the calyx tubes.
 - 1. Fruit winged, dry and leathery *Paliurus*.
 - 2. Fruit a fleshy, usually edible drupe..... *Ziziphus*.
 - B. Ovary adherent to the disk lining the calyx tube; fruit the size of a pea, 3-celled, 3-seeded, on a fleshy edible peduncle.....
..... *Hovenia*.

RHAMNUS

Shrubs or trees. Leaves serrate, alternate or subopposite, pinnately veined, stipules mostly deciduous. Flowers small, perfect or dioecious in racemes, cymes or panicles. Calyx 4-5 toothed; petals 4-5, clawed, emarginate, or absent; petals and stamens inserted on the edge of the disk lining the receptacle. Ovary superior, 3-4 celled; style 3-4 cleft. Fruit a drupe, berry-like, enclosing 3-4 nutlet-like stones.

About 90 species in the temperate and warm regions of the world.

The fruits and bark of several species, particularly that of *Rhamnus cathartica*, widely distributed over Europe & N. Asia, contain a bitter

property used in medicine as a cathartic. Other species yield dyes. *R. frangula* Linnaeus, native of Europe, N. Africa, W. Asia & Siberia, yields a wood that makes a fine grade of charcoal for the manufacture of gunpowder. With rare exceptions the genus is shrubby, and is of ornamental interest only.

Rhamnus cathartica is a favorite hedge plant in Europe.

***Rhamnus davuricus* (Maxim.) Pallas.**

(*R. cathartica* var *dahurica* Maximowicz.)

A large spiny shrub or small tree up to 10 m. tall. Winter buds scaly. Branchlets stout, thorny and glabrous. Leaves opposite, oblong-elliptic, acuminate, crenate-serrate, tapering toward the base, coriaceous, glabrous and gray-green beneath, 5-10 cm. long. Flowers in few-flowered clusters, petals usually 4 (sometimes 5 or wanting). Fruit black, about 8 mm. in diameter.

Amurland to N. China.

***Rhamnus utilis* Decaisne.**

A shrub closely allied to the above. The leaves yield a green dye. Widely distributed from Szechuan to Chekiang.

***Rhamnus crenatus* Siebold & Zuccarini.**

Shrub 3 m. tall. Winter buds naked. Branchlets and young leaves brownish pubescent; leaves long acuminate, 5-10 cm. Flowers umbellate, petals 5; peduncles shorter than the petioles. Fruit changing from red to blue-black.

Hupei, Szechuan, Kiangsi, Chekiang to Fukien.

ZIZIPHUS

Deciduous or evergreen shrubs or trees. Branches rounded, armed with usually unequal spines, one straight and the other curved. The spines are modified stipules. Leaves alternate, entire or serrate, usually appearing 2 ranked, firm, 3-5 nerved at the base, short petioled. Flowers small greenish or whitish, pentamerous, in axillary cymes. Ovary usually 2 (2-4) celled, free from the disk lining the calyx tubes; style usually bifid. Fruit a drupe with 1-3 celled stone.

About 40 species in the tropics and warm temperate regions. The fleshy drupe of several species is edible. Propagated by seeds and by greenwood cuttings. Besides the cultivated trees, shrubby species producing inferior fruits but which may be planted as hedges, and in arid situations, occur in this country.

Ziziphus jujuba Lamareck.

Tree 10-16 m. high, usually prickly. Branchlets, petioles and inflorescence tomentose. Leaves 2.5-8.5 cm. long, oval to oblong, obtuse, entire or serrate, tomentose below. Fruit subglobose, 1.4-2 cm. long, orange-red, stalk about 1/2 the length of the fruit.

S. Asia and Africa.

This is the common cultivated Jujube and between 300 and 400 horticultural varieties have been developed in this country. The tree has a more or less pendulous habit, and besides being a valuable fruit tree is desirable for ornamental planting, as the handsome light green foliage, and attractive, bright colored fruits produced in great profusion are most pleasing to the sight. The fruits show great variation in shape and size, some being almost round, others oblong; some are small while others are as large as an egg, varying in color from red or brown.

Ziziphus sativa Gaertner.

(*Z. vulgaris* Lamareck.)

Common Jujube.

Glabrous shrub or tree to 17 m. high, thorny or unarmed. Leaves 2-5 cm. long, ovate to ovate-lanceolate, acute or obtuse, oblique at the base, serrulate. Flowers yellowish, in axillary cymes. Fruit 1.4-2 cm. long, ovoid or oblong, dark red to almost black, short stalked.

S. Europe, S. & E. Asia.

Cultivated as a fruit tree in China. The heartwood, leaves, roots, and fruit are all medicinal.

PALIURUS

Shrubs or trees, usually armed with spines developed from the stipules, the spines usually unequal, one straight, the other curved and pointing downwards. Leaves alternate, arranged in two ranks, simple, usually ovate, entire or serrate, 3 nerved at the base, stalked. Flowers

small, perfect, yellowish-green, in axillary, rarely terminal cymes; petals 5, more or less 2 lobed; stamens 5; ovary 3 celled; stigmas 3, oblong. Fruit a globose, depressed, woody, 3 celled body entirely surrounded by a flat, circular wing. Seeds 1 in each cell, albuminous.

Six species, in S. Europe, China and Japan.

The curious fruit resembling a Chinese cymbal is very distinctive. The shrubby species are suitable for hedges. Propagated by seeds sown in the autumn or stratified until spring, also by layers and root cuttings.

***Paliurus orientalis* Hemsley.**

Tree to 16 m. tall with or without thorns. Bark smooth, gray; trunk slender, usually spiny. Leaves dark green, somewhat leathery, glabrous, ovate to ovate-lanceolate, crenate-serrate, 5-10 cm. long. Flowers slender peduncled. Fruit 2.5-4 cm. across, purplish, glabrous.

Kiangsu, Kiangsi, Hupeh, Szechuan, Shensi, Kwangtung, Yunnan. The wood is hard and tough.

***P. hirsutus* Hemsley.**

Shrub.

Kwangtung.

***P. ramosissimus* Poiret.**

Shrub.

Kwangtung, Kiangsi, Hupeh, and Szechuan.

Formosa and Japan.

HOVENIA

Armed shrub or tree. Leaves deciduous, alternate, 3 nerved at the base, long petioled. Inflorescence in a pedunculated, many flowered, axillary or terminal cyme. Flowers greenish, small and inconspicuous; calyx 5 parted; petals 5, inserted below the disk, clawed; stamens 5, a little longer than the petals; style 3 parted; ovary enclosed in the disk, 3 celled. Fruit the size of a pea, indehiscent, 3 celled, 3 seeded, on a thickened, fleshy stalk or peduncle.

One species in the Himalayas, China and Japan. *Hovenia* is usually a small round-headed tree with small greenish flowers in cymose clusters followed by numerous small fruits borne on fleshy, red peduncles which are sweet and edible.

Hovenia dulcis Thunberg.

Chi Ku. Raisin Tree.

Tree to 25 m. tall or rarely taller, with deep gray, fissured bark. Leaves ovate-acuminate, or cordate-ovate, serrate or sometimes entire, membranous, glabrous or rarely more or less pubescent, 10–15 cm. long, 5–8 cm. wide.

The sweet, fleshy peduncles are edible. The tree is extensively planted.

TILIACEAE

Trees or shrubs or herbs. Leaves alternate, simple, entire or lobed; stipules small, deciduous. Flowers perfect, regular; sepals 3–5, valvate, free; petals as many as the sepals, rarely wanting. Stamens numerous, attached to a torus or disk, their filaments free or variously united. Ovary superior, free, 2–10 celled; ovules 1 to several in each cell; style 1. Fruit fleshy or dry, dehiscent or indehiscent, 1–several seeded; seeds usually albuminous.

About 36 genera and 400 species, mostly tropical, but widely distributed throughout the world. Most members of this family contain a mucilaginous property which has rendered several species available for medicinal use.

Tilia is the only important arborescent representative in China.

TILIA

Trees with tough, fibrous inner bark, slender branches, and zigzag or 2 ranked twigs. Leaves simple, alternate, arranged in 2 rows, acute, serrate, usually obliquely cordate at the base, occasionally truncate or rounded; venation pseudopalmate, the midrib subtended by 4 or 5 veins radiating from the base of the leaf or apex of the leaf-stalk. Flowers in cymes, regular, perfect, white, fragrant; peduncle united half its length with the midrib of an elongated, membranous, light green persistent bract. Petals 5, alternating with 5 sepals. Stamens numerous, free or united into 5 clusters, attached to a petaloid scale placed opposite each petal. Ovary sessile, 5 celled, 2 ovuled. Fruit nut-like, woody, globose, sometimes ribbed, 1 celled, 2 seeded by the obliteration of the partitions and by abortion, attached to the persistent leaf-like bract.

About 20 species are recognized, all in the temperate northern hemisphere. About 20 species occur in China. Linden or Basswood is the common English name.

The wood is light in weight, used in interior finish and for woodenware, and the fibrous inner bark is fashioned into nets, cords and mats, and in Russia, Sweden and China it is woven into shoes and sandals.

***Tilia tuan* Szyszyłowicz.**

Tree 10–16 m. tall. Young branchlets glabrous or nearly glabrous. Leaves thin, ovate, 5–13 cm. long with oblique and slightly cordate base, long pointed at the apex, minutely and indistinctly dentate on the upper margin and nearly entire at the base; upper surface nearly smooth, lower surface covered with a white, stellate tomentum, and with axillary tufts of hair; petioles up to 6 cm. long, tomentose. Inflorescence cymose, 10–30 flowered. Floral bract 8–13 cm. long, glabrous above except along the veins, tomentose below. Petals ovate-lanceolate, ovary globose, tomentose.

Western and Central China.

The inner bark of this species is used to make sandals worn by the mountaineers.

***Tilia oliveri* Szyszyłowicz.**

Tree to 25 m. tall, with somewhat drooping branches. Young branchlets shiny reddish-brown and glabrous. Winter buds large. Leaves short acuminate, ovate, cordate or truncate at the base, distinctly sinuate dentate with short glandular teeth, or sometimes the dentation obscure, dark green and glabrous above, covered by a dense, close, white, stellate tomentum beneath, 5–12 cm. long. Inflorescence cymose, pendulous, many flowered, bracts sessile. Fruit globose or obovoid, obscurely ribbed, tuberculate, tomentose and shortly apiculate.

Central China. A very ornamental species.

***Tilia mongolica* Maximowicz.**

Tree to 10 m. tall. Branchlets glabrous, reddish. Leaves coarsely serrate and usually 3 lobed, dark shiny green above, glaucous and with axillary tufts of simple hairs beneath, 4–5 cm. long.

Mongolia to Chihli.

The small birch-like leaves are very distinctive.

Plate 86. *TILIA TUAN* Szyszylowicz

1. Flowering branch; 2. Fruiting branch; 3. Section of pistil; 4. Stamens; 5. Petal & stamens; 6. Petal; 7. Stellate hairs. (Details enlarged.)



Plate 87. *TILIA MONGOLICA* Maximowicz

1. Flowering branch; 2. Fruiting branch; 3. Flower; 4 & 5. Petals;
6. Petals and Stamen; 7. Pistil; 8. Section of fruit. (Details
enlarged.) After Faxon.

Tilia mandshurica Ruprecht & Maximowicz.

Tree to 20 m. tall. Branchlets and buds tomentose. Leaves large, coarsely dentate with long pointed teeth, pubescent above, densely white tomentose beneath, 10–15 cm. long. Fruit globose, tomentose, with or without 5 ribs.

Manchuria, Korea and N. China.

Tilia henryana Szyszylowicz.

Tree to 15 m. tall with light gray, fissured bark. Branchlets and leaves in the spring covered with conspicuous white tomentum, becoming less so with age. Leaves 5–13 cm. long, with bristly pointed teeth, brownish tomentose beneath. Flowers 20 or more in a cyme. Fruits obovoid or ovoid, 5 angled, slightly tuberculate, apiculate, to 90 mm. long.

Hupei and Kiangsi.

The aristate pointed leaves are characteristic.

Tilia chinensis Maximowicz.

Tree to 15 m. tall with numerous spreading branches; winter buds large. Branchlets glabrous. Fruit ovoid to obovoid, 5 ribbed, 9–12 mm. long, 6–8 mm. across.

Hupei and Szechuan.

The inner bark is fibrous, used for the making of sandals.

Other Chinese species are:—

T. paucicostata Maximowicz.

Tree to 13 m. tall. Branchlets glabrous. Buds large, purplish. Leaves about 6 cm. long, green on both sides, with long pointed teeth, the tertiary veins not prominent.

W. China.

T. babilis Rehder & Wilson.

Tree 12 m. tall with very large leaves.

W. China. Rare.

T. laetevirens Rehder & Wilson.

Kansu.

T. intonsa Wilson.

Is probably only a form of *T. chinensis*.

STERCULIACEAE

Trees, shrubs or herbs, sometimes climbers. Leaves alternate, simple, lobed or digitate, stipulate. Flowers perfect or unisexual, regular, usually in cymes; sepals 3-5, more or less connate; petals 5, or reduced, or absent; stamens very diverse, usually 5, with or without staminodes, or numerous with filaments united into a tube; anthers 2 celled, in heads, or in a ring, or scattered. Ovary free, 4-5 (rarely 10-12) celled; style as many as the cells, distinct or connate; ovules 2 to indefinite (rarely 1) in each cell. Fruit dry or fleshy, dehiscent or indehiscent.

About 48 genera and 750 species, mostly in the tropics. Cocoa and chocolate are derived from *Theobroma cacao*, native of S. America, now cultivated in tropical Asia and Africa.

KEY TO GENERA

- I. Petals present, flat, deciduous; fruit a 5-valved capsule....*Reevesia*.
- II. Petals wanting; fruit follicular, dehiscent.....*Sterculia*.

STERCULIA

Trees or shrubs. Leaves simple, palmately lobed or digitately compound. Inflorescence clustered, usually axillary. Flowers unisexual or polygamous, with the pistillate frequently terminating the flower spike; calyx tubular, 4-5 parted, frequently colored; petals none; stamens united into a tube, bearing a ring of 10-15 sessile, 2 celled anthers at the apex; pistil sessile or stipitate, composed of 4-5 carpels; carpels 2-many ovuled; style connate at the base; stigma free, radiating. Fruit follicular, composed of distinct, woody or membranous carpels, sometimes foliaceous. Seeds 1-many, naked, sometimes arillate or winged.

About 100 species native in the tropics of both hemispheres, especially abundant in Asia.

***Sterculia lanceaefolia* Roxburgh.**

Tree to 15 m. tall with ashy gray bark. Leaves oval to lanceolate, entire, abruptly acuminate, rounded at the base, glabrous, 10-20 cm. long, 2.5-8 cm. broad; petiole 1.2-2.5 cm. long, thickened at both ends. Racemes 5 cm. long, few flowered; calyx 5 parted, scarlet. Follicles 1-5, beaked, pink. Seeds 4-8, shiny black, ovoid.

India and Southwest China.

Suitable for street planting in warm temperate regions. The fleshy seed coat is edible; the slightly acid, oily seeds are sometimes used to season food.

Sterculia platanifolia has now been placed under *Firmiana*. A description of this tree follows:—

***Firmiana simplex* (L.) W. F. Wight.**

(*Hibiscus simplex* Linnæus.)

(*Firmiana planlanifolia* Britain.)

(*Sterculia platanifolia* Linnæus fil.)

Wu Tung. Phoenix Tree.

Round headed, slender tree up to 16 m. tall with smooth, gray-green bark. Leaves deciduous, large, 3-5 lobed, maple-like, cordate at the base, glabrous or tomentose, averaging 16-20 cm. long; petiole nearly as long as the blade. Flowers small, yellowish green in terminal panicles. Fruit a follicle, 3-10 cm. long, pointed, composed of 4-5 carpels bearing 3-4 globular, pea-like seeds, on the edge near the base. Widely planted.

Hupeh, Shantung to Formosa.

This is the Phoenix Tree of legendary interest. It makes an admirable street tree. The bark yields a fiber obtained by retting. According to Hosie the wood is used for making furniture in Szechuan. The fruit contains a dark colored fluid which is liberated when the follicle opens.

REEVESIA

Shrubs or trees. Leaves simple. Flowers perfect, numerous, white, in terminal paniced cymes; calyx 5 parted, campanulate or funnel-shaped; petals 5, clawed, deciduous; anthers in a globose head on top of the elongated, staminal column; ovary 5 lobed, 5 celled; ovules 2 in each cell. Fruit a capsule, 5 valved; seeds 1-2, winged.

About 2 species in Eastern Asia.

***Reevesia pubescence* Masters.**

Tree to 15 m. tall. Leaves 10-13 cm. long, 5-6.5 cm. wide, subcoriaceous, pubescent beneath, oblong, acuminate, cordate at base. Flowers numerous; petals pink, longer than the calyx. Fruit woody, obconical, (top-shaped), 4-5 cm. long, 2.5 cm. wide at the depressed apex.

India and S. W. China.

THEACEAE

Trees or shrubs. Leaves alternate, entire, leathery or membranous. Flowers usually perfect, regular, generally showy, axillary, solitary or clustered; sepals 5 (5-7), imbricated; petals 5 (4-9), free or slightly connate below; stamens numerous, rarely fewer, free or connate, usually adnate to the base of the corolla; ovary superior, 3-5 (-10) celled; ovules 2 (1-many) in each cell; styles as many as the cells, free or connate. Fruit a capsule, or drupaceous, or dry and indehiscent.

Sixteen genera and about 174 species. *Theasinensis* (Tea) is the most important member of the family. *Actinidia* is now placed under *Dilleniaceae*. *Ternstroemiaceae* is a synonym of the family.

KEY TO GENERA

- I. Stamens monadelphous; fruit a woody 5-angled capsule; styles 5
.....*Stewartia*.
- II. Stamens 5-adelphous; style 1; fruit a woody 5-6 celled capsule..
..... *Gordonia*.

STEWARTIA

Deciduous shrubs or trees. Leaves alternate, serrate, short petioled. Flowers axillary or subterminal, large, white and showy, subtended by the bracts; sepals 5; petals 5; stamens numerous, monadelphous; styles 5, free or connate. Fruit a 5 angled woody capsule dehiscent into 5 valves. Seeds usually narrowly winged, 1-4 in each cell.

About 6 species in China, Japan and E. America.

Stewartia sinensis Rehder & Wilson.

Shrub or tree to 10 m. tall. Leaves membranous, oblong-elliptic to obovate-elliptic, acuminate, base narrow or slightly rounded, remotely or acutely serrate, yellow-green and glabrous above, sparingly pubescent below, 6-10 cm. long, 2-4 cm. wide; petiole 5-8 mm. long. Flowers solitary, white; bract leafy, 2-2.5 cm. long; stamens monadelphous; style connate. Fruit subglobose, pointed, 2 cm. across. Seeds about 1 cm. long, compressed, with a brown wing.

Hupei, Szechuan, Kiangsi.

GORDONIA

Evergreen or deciduous trees or shrubs. Leaves alternate, coriaceous, entire or serrate, petioled. Flowers solitary, axillary, white and showy; sepals 5, unequal, imbricated; petals 5, obovate, free or slightly connate at the base; stamens numerous, 5-adelphous or altogether; ovary superior, 3-5 (rarely 6) celled; ovules 4-8 in each cell; style 1; stigma 3-6 lobed. Fruit a woody capsule, 3-6 celled, with a persistent axis. Seeds winged.

Sixteen or 17 species in tropical and subtropical Asia and E. N. America. Two species in China.

***Gordonia axillaris* Szyszylowicz.**

Shrub or small tree to 8 m. tall. Leaves oblong-obovate or oblanceolate, obtuse, entire or serrate, dark green above, short petioled, 8-15 cm. long. Flowers large, 5-8 cm. long, creamy white, nearly sessile; sepals obcordate, purplish brown; petals roundish, obovate to obcordate; ovary 4 or 5 celled. Capsule brown, oblong-ovate. Seeds with a terminal wing.

Szechuan, Yunnan to Hongkong and Formosa.

***Gordonia sinensis* Hemsley & Wilson.**

Tree to 10 m. tall with gray longitudinally and shallowly fissured bark. Leaves ovate-lanceolate, acute, crenate-serrate, 12-18 cm. long; petiole up to 1.5 cm. long. Flowers on a peduncle; peduncle about 4 cm. long; ovary 5 celled; stigma capitate.

Szechuan on Omei Shan.

FLACOURTIACEAE

Trees or shrubs, rarely climbers. Leaves alternate, simple. Flowers regular, perfect or unisexual. Petals hypogynous, imbricated, as many as the sepals, (10-0) or none; sepals 2-15; stamens numerous, hypogynous or perigynous. Torus often glandular and dilated, frequently surmounted by a variously modified disk. Ovary usually 1 celled with several parietal placentae; ovules 2 to many on each placenta. Style 1 to several. Fruit fleshy or dry, indehiscent or splitting into valves. Seeds with more or less fleshy albumen.

A family of 70 genera comprising more than 500 species, distributed throughout the tropics. Several tropical genera yield edible fruits, or seeds that produce cooking or other oils.

KEY TO GENERA

- I. Flowers in axillary racemes; sepals 4 or 5, imbricate; ovary 1 celled, superior; leaves pinnately veined, persistent; fruit a 2-3 seeded berry.....*Xylosma*.
- II. Flowers in terminal panicles.
 - A. Leaves pinnately veined, short stalked; calyx 3-4 parted; fruit a woody capsule.....*Itoa*.
 - B. Leaves 3-5 nerved, long stalked, deciduous.
 1. Fruit a many seeded berry; styles usually 5; sepals imbricate, usually 5.....*Idesia*.
 2. Fruit a capsule.
 - a. Styles 3, 2 parted at the apex, sepals ovate-lanceolate; capsule 3 cm. long or less.....*Poliothyrsis*.
 - b. Styles 3-4, 3 parted at the apex; sepals cordate-ovate, large, white; capsule 5-9 cm. long.....*Carrierea*.

ITOA

Tree. Leaves alternate, coriaceous, oblong to elliptic, acuminate, rounded at the base, serrate, 34-40 cm. long; petiole to 6 cm. long. Flowers in erect, terminal panicles, unisexual, apetalous; calyx 3 parted (4); stamens numerous. Capsule woody, narrow ovoid, 1 celled, 9-10 cm. long. Seeds numerous, winged.

1 species in Yunnan and Szechuan.

Itoa orientalis Hemsley.

Tree about 12-15 m. tall with light gray bark.

Itoa is distinguished from *Poliothyrsis* by the coriaceous, longer, oblong, pinnately veined, shorter petioled leaves, by the 3-4 parted calyx, numerous stamens, and by the large, tardily dehiscent, woody capsule.

The wood is said to be tough.

POLIOTHYRSIS

Deciduous trees. Leaves alternate, with 3 main veins from the base, ovate, pointed, shallowly toothed. Flowers monoecious, unisexual by abortion, apetalous, in large, erect panicles; calyx with 5 ovate-lanceolate lobes; stamens 20-25; ovary ovoid, tomentose, 1 celled, many ovuled; style 3; stigma bifid. Fruit an ellipsoid capsule, splitting into 3 valves. Seeds small, winged.

A monotypic genus confined to Western China. Distinguished from *Idesia*, which it resembles in foliage and habit, by the capsular fruit. The fruit of *Idesia* is a dark red berry. The base of the leaf or apex of the petiole usually bears minute glands on the upper surface.

***Poliothyrsis sinensis* Oliver.**

Tree to 13 m. tall with gray bark. Leaves more or less ovate, rounded or cordate at base, 6 or 8 to 15 cm. long, 5 or 6 to 9 or 10 cm. wide, at first pubescent beneath; petiole slender, 3-4 cm. long. Flowers greenish white, changing to yellow, about 8 mm. across. Capsule 1-3 cm. long, 6-10 mm. wide, tapering to both ends. Seeds winged.

Hupeh and Szechuan.

XYLOSMA

Evergreen trees or shrubs, often spinescent. Leaves alternate, dentate or crenate, pinnately veined, without stipules. Flowers small, dioecious, rarely perfect, apetalous, in axillary racemes; sepals 4-5, small, imbricate, slightly connate at the base; stamens many, distinct; ovary superior, surrounded by a glandular disk, 1 celled, with 2, (rarely 3-6) few ovuled parietal placentae; styles 2 or more. Fruit a globose, 2-3 seeded berry.

About 45 species in the tropics. The wood of some species is aromatic, a feature that is responsible for the latter part of the generic name.

***Xylosma racemosum* (S. & Z.) Miquel.**

(*Hisingera racemosa* Siebold & Zuccarini.)

Shrub or tree sometimes to 20 or 25 m. tall, spiny or unarmed. Branchlets glabrous or minutely pubescent. Leaves ovate, acuminate, rounded at the base, serrate, 4-5 cm. long. Racemes to 2.5 cm. long. Flowers yellow, fragrant, about 5 mm. across. Fruit black, 2-3 seeded, to 5 mm. in diameter.

E. China to Korea and Japan. In Western Szechuan this tree is known as the Tung-ching or "Winter-green" tree. It is commonly planted around temples, esteemed for its beauty.

IDESIA

Trees. Leaves deciduous, alternate, 3-5 nerved at the base, remotely serrate, acute, more or less cordate, long petioled. The petioles and leaf bases often with a few conspicuous glands or nectaries. Flowers apetalous, dioecious, in terminal panicles; sepals 5, sometimes 3-6, imbricate; ovary globose, 1 celled; styles 5. Fruit a berry with many seeds embedded in a pulpy flesh.

1 species in Central and W. China and S. Japan.

***Idesia polycarpa* Maximowicz.**

Tree about 15 m. tall with smooth gray bark. Leaves ovate or oblong-ovate, cordate at the base, acuminate, remotely crenate-serrate, dark lustrous green and smooth above, glaucous and glabrous or pubescent below, averaging about 15 cm. long; the petioles very variable, from 2.5 to 5 or 6 cm. long. Flowers greenish-yellow, in pendulous panicles, 10-15 cm. long. Staminate flowers 12 mm. in diameter. Pistillate flowers smaller. Berries orange red, borne in long pendulous clusters.

China, Korea, Formosa and Japan.

A very common tree in Western Hupeh. The leaves resemble those of the *Catalpa* in appearance, though they are thicker and smaller. The bright red fruits in grape-like clusters are particularly handsome. Propagated by seeds.

CARRIEREA

Deciduous tree. Leaves alternate, ovate, acuminate, serrate, rounded or cordate at the base, long petioled. Flowers dioecious, apetalous, in terminal, tomentose panicles, with 2 foliaceous bracts at the base of each flower stalk; sepals 5, pubescent; stamens numerous, shorter than the sepals; ovary ovate-oblong, 1 celled, many ovuled, rudimentary in the staminate flower; styles 3-4, very short, stigma 3 parted. Fruit a large, lanceolate capsule, dehiscent into 3 valves. Seeds numerous, winged.

The following is a handsome tree and the only species known.



Plate 88. *IDESIA POLYCARPA* Maximowicz

1. Fruiting branch ; 2. Pistillate inflorescence ; 3. Staminate inflorescence ; 4. Staminate flower ; 5. Pistillate flower ; 6. Section of fruit ; 7. Stamen ; 8. Seed. (Details enlarged.)

Carrierea calycina Franchet.

Tree 10 m. tall. Leaves 8-15 cm. long, half as wide, acuminate, crenate, ovate to elliptic or obovate, glabrous, at first reddish, later green. Flowers white, firm in texture; 2-5 cm. in diameter; sepals cordate-ovate. Capsule 5-9 cm. long, pubescent. Seeds winged.

Central China.

This tree resembles *Idea* in appearance. The apetalous flowers with large, white sepals, the staminate more numerous, the pistillate few or solitary, and the capsular fruit are distinguishing characters.

ELEAGNACEAE

Trees or shrubs with silvery or brown scales or stellate hairs. Leaves alternate or opposite (*Shepherdia*), simple, entire. Flowers perfect, polygamous or dioecious, regular, apetalous, clustered or rarely solitary; perianth of staminate flower 2 or 4 parted; perianth of pistillate or perfect flower campanulate and 2 or 4 lobed above, tubular or urn shaped below and enclosing the ovary, more or less persistent and becoming fleshy in the fruit; stamens 4 or 8, inserted on the tube; disk annular or lobed; ovary superior, sessile, 1 celled, 1 ovuled; style and stigma 1. Fruit an achene, enclosed in the fleshy receptacle, appearing drupe-like.

Three genera and about 50 species widely distributed. A family of no great importance, to the forester.

KEY TO GENERA

- I. Flowers perfect or polygamous, solitary or 2-4 in a cluster; calyx 4 lobed; fruit oblong*Eleagnus*.
- II. Flowers unisexual, usually dioecious, in short racemes; calyx minutely 2 lobed; fruit globose*Hippophae*.

ELEAGNUS

Deciduous or evergreen shrubs or trees, sometimes spiny, and mostly with silvery scales or stellate pubescence. Leaves alternate, entire, petioled. Flowers axillary, solitary or in clusters of 2-4, perfect or

polygamous, apetalous, small and inconspicuous but usually fragrant; perianth tubular, or campanulate, constricted above the ovary, 4 lobed; stamens 4, inserted on the perianth and included, on short filaments. Fruit drupe-like with a striated or grooved seed.

About 40 species in Europe, N. America and Asia, nearly all of them shrubby. Many species have silvery foliage and ornamental fruits and delicately scented though inconspicuous flowers.

***Eleagnus umbellata* Thunberg.**

Usually a large shrub, sometimes a small tree 5 or 6 m. tall. Often spiny. Branchlets brownish, often silvery. Leaves oval to ovate-oblong, silvery white above and beneath, especially when young, 4-8 cm. long. Flowers fragrant, yellowish, with slender elongated tube longer than the perianth lobes. Fruit globose or oval, red with silvery and brown scales, about 8 mm. long; peduncles up to 12 mm. long.

Himalayas to China, and Japan. Szechuan, Hupeh, Kansu, Shansi, Shantung.

The remaining 11 or 12 species in this country are shrubby.

HIPPOPHAE

Shrubs or trees with silvery scales on young twigs and leaves, often spinescent. Leaves alternate, narrow, silvery gray. Flowers dioecious, inconspicuous, yellow, in short racemes. Staminate flowers sessile; sepals 2; stamens 4. Pistillate flowers short stalked; calyx minutely 2 toothed. Fruit drupe-like, globose, orange or yellow.

2 species in Europe and W. and C. Asia.

H. salicifolia D. Don is the Himalayan species.

***Hippophae rhamnoides* Linnæus.**

Deciduous shrub or small tree, sometimes 12 m. tall. Young plants covered with silvery scales. Branches gray and often spinescent. Leaves linear-lanceolate, very short petioled, gray-green above, silvery-gray beneath, 2.5-8 cm. long. Flowers appearing before the leaves. Fruit subglobose to ovoid, orange-yellow, 6-8 mm. long.

Europe and temperate Asia. Szechuan, Shensi, Chihli.

This species has running roots, reproducing freely by suckers, and has been successfully used to hold shifting sand. It grows in any kind of soil. The pistillate plant when fruiting is very attractive. The fruits are slightly poisonous.

NYSSACEAE

Trees. Leaves alternate, simple, entire or toothed. Flowers unisexual or polygamous, aggregated in heads or clusters, with or without accompanying bracts; calyx 5 lobed or wanting; petals 5 or wanting; stamens 5-10, or numerous, all alike or in 2 series and unequal; disk present; ovary 1 or 2 celled, or 6-10 celled; usually 1 ovule in each cell; style elongated, curved, or short and thickened, or bifid. Fruit samaroid, or a large or small drupe.

A family represented by 3 genera in China, all chiefly of ornamental value.

KEY TO GENERA

- I. Fruit samara-like, aggregated in a capitate head.....*Camptotheca*.
- II. Fruit drupaceous.
 - A. Drupes small, 1-2 celled, 1 seeded; ovary 1-2 celled; perianth present; the staminate and pistillate flowers in distinct clusters with small deciduous bracts.....*Nyssa*.
 - B. Drupes large with a 3-5 celled stone; ovary 6-10 celled; perianth wanting; inflorescence composed of a single pistillate flower surrounded by numerous staminate flowers or of staminate flowers only, accompanied by 2 or 3 large white bracts *Davidia*.

CAMPTOTHECA

Trees. Leaves alternate, entire, pinnately veined, elliptic-ovate to oblong, acuminate, stalked. Flowers sessile in capitate heads, solitary or in axillary or terminal panicles, unisexual or perfect; calyx cup-shaped, slightly 5 toothed; petals 5, valvate (in aestivation); stamens 10, white, unequal, in 2 series, on slender filaments; disk epigynous, cup-shaped; ovary oblong, depressed at the apex, 1 celled, 1 ovuled; style

bifid. Fruit aggregated in a capitate head, samara-like, sessile, linear, unequal sided, truncated at the apex with a thick, leathery coat, 1 celled, 1 seeded. A monotypic genus confined to China.

Camptotheca acuminata Decaisne.

Tree 20-25 m. tall with smooth, pale gray bark. Leaves 7-15 cm. long, 4-8 cm. wide. Fruit brown when ripe, about 3 cm. long, many crowded in a head.

Kiangsi, Szechuan, Yunnan, Hupeh.

This tree is widely distributed throughout the warmer parts of Central China. It is rapid growing and very beautiful in full bloom. The wood is white and soft, said to be used only for fuel.

NYSSA

Trees. Leaves alternate, entire, rarely remotely 1-4 toothed, petiole, and stipulate. Flowers polygamo-dioecious, minute, greenish. Staminate flowers long pedicelled, in many flowered simple or compound clusters; calyx cup-shaped, 5 toothed; sepals 5, thick, inserted on the disk; stamens 5, exserted, filaments filiform; ovary absent. Pistillate flowers in axillary peduncles, 1-2 or several in a cluster; calyx tube campanulate, 5 toothed; petals 5, small and thick; stamens 5-10; anthers fertile or sterile; ovary 1 or 2 celled; style elongated or curved. Fruit an oblong or ovoid fleshy drupe with a bony, thick-wall, 1-2 celled, usually 1 seeded, stone.

Seven species; 5 in N. America, 1 in S. Asia, and 1 in China.

The genus is characterized by glossy foliage which turns brilliantly red in the autumn. The Jupelos are especially effective for planting along the margin of ponds or near streams. The wood is close grained, suitable for interior finish and furniture making.

Nyssa sinensis Oliver.

Chinese Jupelo.

Bush or small tree. Branchlets and leaves pubescent, later becoming glabrous. Leaves elliptical, acuminate, dark green above, pale shiny green and pubescent along the veins below, 10 to 15 cm. long; petioles pilose, short. Flowers racemose, peduncles long and slender. Staminate



Plate 89. *NYSSA SINENSIS* Oliver

1. Flowering branch; 2. Fruiting branch; 3. Section of ovary; 4. Staminate flower; 5. Staminate inflorescence; 6. Pistillate flower.
(Enlarged details from Hooker's "Icones Plantarum" Pl. 1964.)

inflorescence many flowered; petals narrow-oblong; stamens 5-10. Pistillate few, on slender stalks; ovary glabrous. Fruit short pedicelled, in clusters of 2 or 3, on long, ascending peduncles, 2-5 cm. long. The flesh is thin. Stone ridged.

Hupei and Kiangsi. Common along water courses near Kuling in Kiangsi, elsewhere said to be rare.

DAVIDIA

Deciduous trees. Leaves alternate, coarsely dentate, slender petioled and without stipules. Inflorescence polygamous, in a terminal, subglobose head, pendulous on a long peduncle, more or less concealed by overhanging bracts. The bracts are usually 2 in number, rarely 3, large, conspicuous, unequal in size, sessile, leafy, creamy-white, thin and membranous, entire or remotely serrate, rounded or cordate at the base, deciduous. The flowering head composed of a single perfect flower entirely surrounded by numerous staminate flowers, or consists entirely of staminate flowers. Staminate flowers achlamydeous, the perianth reduced to a swollen ring; stamens 1-7, filaments filiform, anthers purple. The perfect flowers are naked, subsessile, obliquely attached to the head; stamens shortly epigynous, attached to the base of the thickened style on top of the ovary; stigmas spreading, as many as the cells; ovary inferior, 6-10 celled, 1 ovule in each cell. Fruit a drupe; flesh thin; stone 3-5 celled.

A genus containing a single species, native of China.

Davidia involucrata Baillon.

Tree 18 m. tall. Leaves bright green, ovate or ovate-cordate, acuminate, coarsely serrate with glandular teeth, prominently veined, more or less pubescent below, 6-13 cm. long and 5-8 cm. wide. Petiole 2.5-10 cm. long. The larger bract sometimes 15 cm. long. Inflorescence about 3 cm. across; peduncle of fruit about 10 cm. long. Fruit 4 cm. long, oblong-ovoid, greenish-yellow, marked by reddish-brown spots; epicarp thin; stone hard, bony, deeply grooved and channeled.

Var. **vilmoriniana** Dode.

A glabrous form of the above.

Hupei and Szechuan.

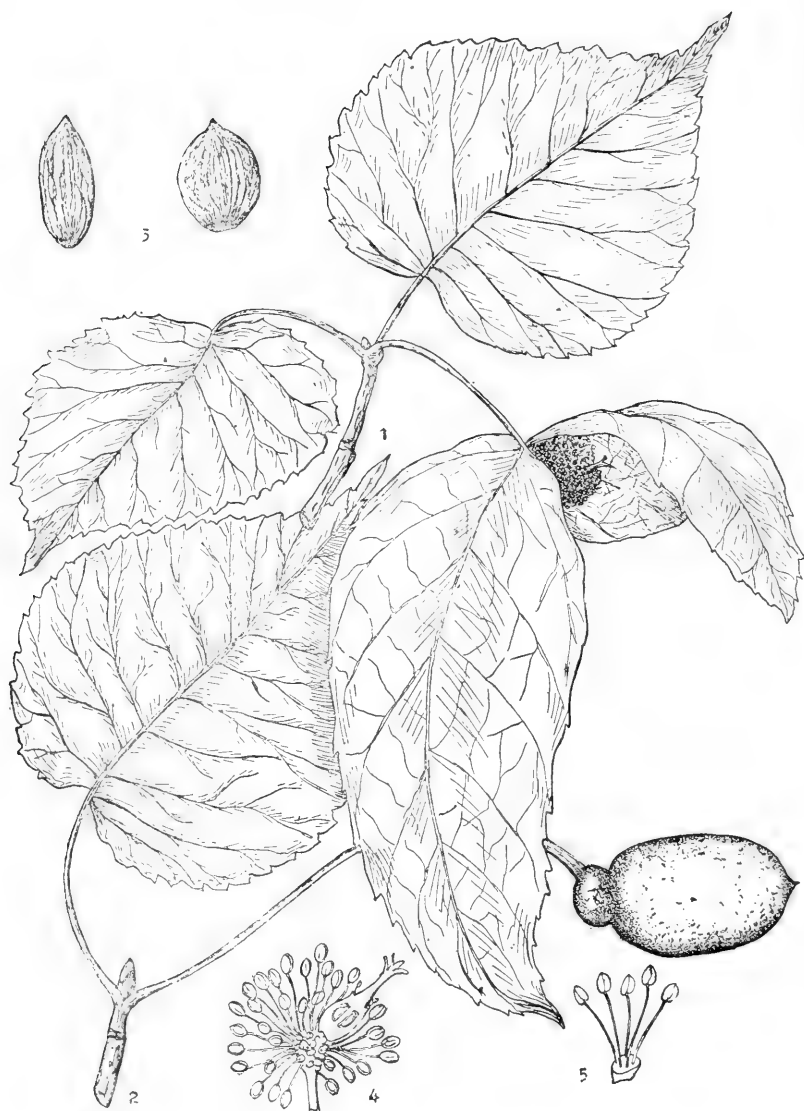


Plate 90. *DAVIDIA INVOLUCRATA* Daillon

1. Flowering branch; 2. Fruiting branch; 3. Seeds; 4. Inflorescence;
5. Staminate flower. (5 enlarged.)

Among all the Chinese trees, there is none more interesting or distinctive than the *Davidia*. It is a remarkably beautiful tree in full bloom, with the large creamy-white bracts fluttering against the background of the bright green leaves. It is well worthy of general cultivation in gardens in the temperate parts of the country.

ARALIACEAE

Trees, shrubs or herbs, erect or climbing, sometimes spiny. Leaves alternate, simple, or pinnately or digitately compound, or decompose. Flowers regular, umbellate or paniced, perfect or unisexual, small and epigynous. Parts of the flowers usually in 5's. Sepals minute, sometimes wanting; petals rarely more than 5; stamens alternate with, rarely 2 or 3 times as many as, the petals. Ovary inferior, 2-5 celled; 1 ovule in each cell. Styles as many as the cells. Fruit a dry or fleshy berry with the calyx persistent at the apex.

About 51 genera containing 400 species, chiefly tropical. A few genera extend into the temperate regions of N. America and E. Asia.

KEY TO GENERA

- I. Petals imbricate; leaves pinnate to decompose.....*Aralia*.
- II. Petals valvate; leaves simple, palmately lobed, or digitately compound
.....*Acanthopanax*.

ARALIA

Trees, shrubs or herbs, often with prickly stems, the prickles being modified hairs. Leaves deciduous, alternate; pinnately compound or decompose; leaflets serrulate; stipules on the expanded clasping base of the petiole. Flowers with imbricate petals, small, whitish, perfect or polygamous, usually in umbellate panicles. Petals and stamens 5. Ovary 2-5 celled, adnate to the calyx tube. Styles 2-5, free or slightly connate at the base. Fruit a berry-like fleshy drupe more or less angled, with 2-5 hard compressed stones.

About 30 species in Asia and N. America. Valuable for ornamental planting. Easily propagated by seeds, suckers and root cuttings.

***Aralia chinensis* Linnæus.**

Chinese Angelica Tree.

Shrub or tree to 8 m. tall, often with several stems and few, very thick, prickly branches, spreading freely from root suckers. Leaves often 1 m. long, decompose. Leaflets ovate, acuminate, coarsely serrate or dentate, bright green above, pubescent or glabrescent or glaucous below, short stalked, 6-15 cm. long. Flowers appear in late summer, small, whitish, in numerous, globose umbels in a long panicle, 60 cm. long; pedicels tomentose; styles distinct. Fruit small, black, numerous.

China and Japan.

This species shows much variability, particularly in the canescent or glabrescent character of the leaflets, which has led some botanist to establish a variety *canescens* and a variety *glabrescens* which, however, need not be considered by the practical botanist.

***Aralia wilsonii* Harms.**

A shrub 2-3 m. high resembling *A. chinensis* and apparently chiefly differing in their glabrous or nearly glabrous inflorescence and foliage, the under surface of the leaflets being bright green. The leaflets also appear to have distinctly longer petiolules. May be a form of *A. chinensis*. Found by E. H. Wilson in Western Szechuan.

ACANTHOPANAX

Trees or shrubs. Branches stout, usually with stout prickles. Leaves deciduous, alternate, simple and palmately lobed, or digitately compound, long petiolate. Flowers with valvate petals, small, greenish, perfect or polygamous, in solitary umbels or in large terminal paniced umbels. Calyx tube coherent with the ovary, minutely toothed; petals and stamens 5, inserted together on the edge of the disk. Ovary usually 5 celled, rarely 2. Styles 2-5, more or less connate at the base. Fruit black, a 2-5 seeded berry.

About 18 species in Central and Eastern Asia from Manchuria to the Himalayas.

Propagated by root cuttings, by division, offsets, and by seeds. The number of seeds per pound is about 55,000. They germinate very slowly.

***Acanthopanax ricinifolius* Seeman.**

Tree 25 m. tall. Branchlets red-brown and with stout prickles. Leaves, digitately 5-7 lobed, wider than long, subcordate or nearly truncate at the



Plate 91. *ACANTHOPANAX RICINIFOLIUS* Seeman

1. Fructing branch; 2. Leaf; 3. Flower, enlarged.

base, 15-25 cm. in diameter; lobes ovate-triangular, acuminate, serrate, about $\frac{1}{3}$ the length of the leaf; sinus acute, dark green above, pale green, slightly pubescent below; petiole long, more or less tomentose. Flowers appear in late summer, are umbellate in large terminal panicles, small, white. Styles 2, connate at the base. Fruit small, black and globose.

China, Korea, and Japan. Szechuan and Hupeh to Chekiang and Fukien.

The wood has a disagreeable odor, is fairly hard, compact and straight grained, of a reddish-brown color. It is used in Japan for furniture, for building purposes, and for railway ties.

The young leaves are eaten by the Japanese. The foliage resembles somewhat that of the castor oil plant.

CORNACEAE

Trees or shrubs, rarely herbs with scaly buds. Leaves opposite, rarely alternate, pinnately veined, simple, entire or toothed, without stipules. Flowers perfect, rarely unisexual, regular, epigynous. Calyx 4 or 5 toothed, or wanting; petals 4 or 5, inserted on the calyx and alternate with its teeth. Stamens 4 or 5, alternate with the petals, inserted on the margin of the disk; anthers introrse. Style usually with a capitate stigma. Ovary superior, 2 celled, rarely 1-10 celled. Ovules solitary in each cell, rarely 2. Fruit a 1-2 seeded drupe, or a berry.

The family includes 15 genera and about 120 species, mostly in the temperate regions. *Nyssa*, *Davidia* and *Camptotheca*, are included by some botanists under this family. The evergreen shrub *Aucuba*, with handsome and often variegated leaves and small purple paniculate flowers, belongs to this family.

CORNUS

Trees and shrubs with astringent bark. Leaves deciduous, opposite, rarely alternate or whorled, entire. Flowers small, perfect, white or yellow, in heads or cymes. Calyx minutely 4 toothed; petals 4; stamens 4, alternate with the petals; style simple, capitate; ovary inferior, 2 celled, 1 ovule in each cell. Fruit a drupe with thin flesh and hard stone, 2 celled, 2 seeded.

About 50 species in the northern hemisphere. The bark, leaves and fruit are used in medicine for their astringent and tonic properties. The genus is highly ornamental. A large number of species have an inflorescence accompanied by showy petal-like bracts which makes the tree extremely attractive in bloom. The brightly colored stem and twigs of some shrubby species render them desirable as decorative subjects.

***Cornus kousa* Buerger.**

(*Benthamia japonica* Siebold & Zuccarini.)

Shrub or small tree up to 10 m. high. Young shoots smooth. Leaves elliptic-ovate, acuminate, cuneate at the base, margin undulate, dark green above, pale green and pubescent below, 5-10 cm. long. Inflorescence appears after the leaves, very showy, composed of small, inconspicuous flowers closely packed in a terminal head, surrounded by 4 showy, creamy-white bracts developed from the 4 accrescent winter bud scales; bracts 3.5-5 cm. long, ovate and slender pointed. Fruit fleshy, in a globose head.

China, Korea and Japan.

This tree presents a strikingly handsome appearance when in bloom.

***Cornus capitata* Wallich.**

(*Benthamia fragifera* Lindley.)

A small tree, 10 m. tall. Leaves leathery, ovate-lanceolate, tapered at both ends, densely pubescent below, slightly pubescent above, 5-10 cm. long. Bracts ovate, acute, yellow. Fruit strawberry-like, scarlet, 2.5 cm. across, composed of numerous small drupes, each containing a stony seed.

Himalayas to China.

China: Hupeh, Szechuan, Yunnan.

***Cornus controversa* Hemsley.**

Tree 18 m. tall. Leaves irregularly alternate, ovate, rounded at the base, acuminate. Flowers in umbel-like cymes, cream colored, 8-10 cm. wide. Fruit blue-black.

Himalayas, China and Japan.

Kiangsi, Hupeh, Szechuan, Yunnan.



Plate 92. *CORNUS KOUSA* Buerger

1. Flowering branch; 2. Fruit; 3. Ovary; 4. Section of flower.
(Details enlarged.)



Plate 93. *CORNUS CAPITATA* Wallich

1. Flowering branch; 2. Fruiting branch; 3. Flower, enlarged.

***Cornus macrophylla* Wallich.**

Tree to 10 m. tall. Branches reddish-brown. Leaves broadly ovate to elliptic-ovate, acuminate, dark green above, pale green, glaucous and slightly appressed hairy below, with 5-8 pairs of lateral veins, 10-15 cm. long; petiole slender. Inflorescence a loose, terminal, dichotomous cyme, 5-10 cm. across; flowers white on short peduncles, calyx urn-shaped, style more or less enlarged toward the apex. The pedicels, calyx and the outer surface of the petals are somewhat appressed silky hairy. Fruit a blue-black drupe, about 8 mm. across.

Himalayas to China and Japan. China: Yunnan, Szechuan, Hupeh, and Shensi.

EBENACEAE

Trees or shrubs. Leaves alternate, rarely sub-opposite, entire. Flowers regular, dioecious, rarely perfect; calyx 3-6 parted, persistent and usually enlarged in the fruit. Corolla 3-6 lobed, hypogynous, coriaceous. Stamens usually free from the corolla, as many as its lobes, or twice as many or more numerous. Ovary superior, 2-16 celled; ovules 1 or 2 in each cell. Style 2-8. Seeds albuminous.

Five genera and 280 species, in tropical and subtropical regions, especially in the E. Hemisphere. The unisexual flowers and the superior 2 to many celled ovary are distinctive characters.

DIOSPYROS

Deciduous or evergreen trees or shrubs. Leaves alternate, rarely opposite, entire, without stipules. Flowers dioecious, rarely polygamous, in axillary cymes, or solitary on the axils of the leaves of the year, or lateral on older branches. Calyx usually 4 lobed, occasionally 3-7, accrescent under the fruit. Corolla 3-7, usually 4 lobed, tubular or cup-like, yellow or white. Stamens usually 16 (4 to indefinite). Ovary 4, sometimes 8 celled. Style 1-4, free or united; stigma 2 lobed. Ovules 2 in each cell. Fruit a large juicy or pulpy berry, 1-10 seeded, the enlarged calyx persistent at the base. Seeds oblong, compressed, blackish and lustrous.

About 160 species, most of them in the tropics. The wood is hard, strong and close grained, with thin, pale sap wood and almost black

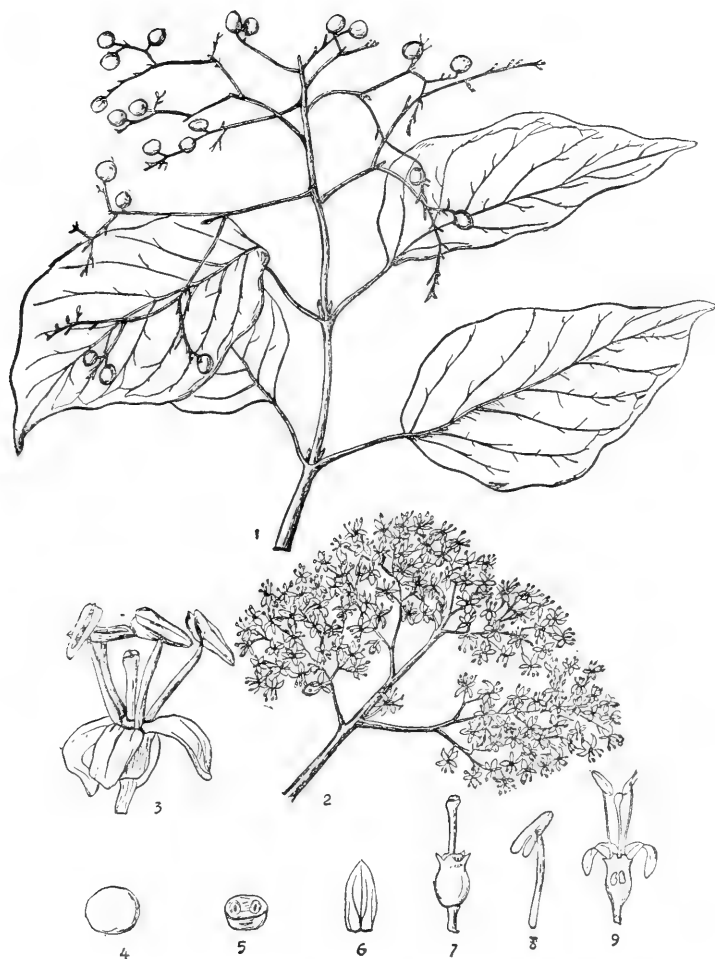


Plate 94. *CORNUS MACROPHYLLA* Wallich

1. Fructing branch; 2. Inflorescence; 3. Flower; 4. Fruit; 5. Section of fruit; 6. Petal; 7. Pistil; 8. Stamen; 9. Section of flower.
(Details enlarged.)

heartwood. The much prized, valuable ebony wood of commerce is derived mostly from *Diospyros ebenum*; other species in the tropics yield various dyes and medicines. Several species are cultivated for their fruits. Propagated by seeds, by cuttings of half ripened wood, and by layers. The horticultural varieties are usually budded or grafted.

***Diospyros lotus* Linnæus.**

Wild Persimmon.

Deciduous trees to 20 m. tall. Leaves elliptic or oblong, 5-13 cm. long, acuminate, membranous and pubescent, shiny green above, paler green below; petiole slender, 12 mm. long. Staminate flowers reddish-white, short stalked, in clusters of 3's. Pistillate flowers solitary. Calyx lobed half way down to the base. Corolla green, tinged with red, glabrous on the outside. Stamens 16. Ovary glabrous except at the apex. Fruit globose, 1.2-2 cm. long, yellow at first, dark purple when ripe and covered with a whitish bloom, sweet and edible.

W. Asia, N. Persia, N. India, N. China. Naturalized in the Mediterranean region. *Diospyros lotus* has been reported as a common tree in the mountains near Peking. The fruit is small, oval, pointed, blackish, sweet and edible when fully ripe. This tree is used as stock upon which the cultivated forms are grafted. The rich black heartwood is very valuable for the manufacture of fancy articles and high grade furniture. For these purposes it rivals the ebony and mahogany of commerce.

***Diospyros kaki* Linnæus.**

Tree 15 m. tall. Leaves 8-18 cm. long. Flowers yellowish-white. Stamens 16-24. Styles divided to the base. Staminate and pistillate flowers differ in size and shape. Fruit very variable, generally orange or yellow, of the size and shape of the tomato, about 8 cm. in diameter.

China. Introduced into Japan.

The common cultivated tree, with many varieties distinguished. Two distinct types occupy distinct localities; the northern type is thin skinned and yellow; the southern type is thick skinned and orange or reddish. The fruit is very variable in size and shape, but in general, it is tomato-like, with one or more furrows around the circumference. The unripe fruit of this species is used to waterproof paper hats and umbrellas. A note on the technique of the making of the varnish may prove



Plate 95. DIOSPYROS LOTUS Linnæus

1. Fruiting branch; 2. Flowering branch; 3. Section of fruit; 4. Seeds; 5. Staminate flower; 6. Pistillate flower. (Details slightly enlarged).



1. PLATE 96, page 274, represents *DIOSPYROS SINENSIS* Hemsley, **NOT** *DIOSPYROS KAKI* as printed through error in substitution of plates.

of interest. The fruits are picked while green and still immature and are pounded into a pulpy mass by means of a wooden hammer, and placed into earthen jars with a quantity of water. The contents of the jar are stirred from time to time and are then left undisturbed for twenty days, after which the pulp is removed and the colorless syrupy liquid which remains is then mixed with the leaves of a certain species of Privet, (Tung-ching) for the purpose of imparting to it a reddish color. The varnish then is ready for use.

STYRACEAE

Trees or shrubs, with more or less stellate pubescence. Leaves alternate, simple, pinnately veined, without stipules. Flowers regular, perfect; calyx 4-5 cleft, more or less adnate to the ovary; corolla 4-5 lobed, the lobes nearly divided to the base; stamens free, in 1 series, or more or less connate at the base, usually twice as many as the lobes of the corolla; ovary imperfectly 3-5 celled; style 1; ovules 1 to several in each cell. Fruit a capsular drupe.

Seven genera and about 100 species in the warm parts of N. and S. America, E. Asia and the Mediterranean region. The family is chiefly useful for ornamental purposes. One of the showy genera in this family is *Halesia*, the Silver Bell of America.

KEY TO GENERA

- I. Ovary superior; calyx tube campanulate; fruit globose or oblong, not ribbed, nor winged.....*Styrax*.
- II. Ovary inferior or subinferior, fruit ribbed or winged, or capsular.
 - A. Fruit ribbed or winged; flowers in panicles; ovary 3 celled ..
.....*Pterostyrax*.
 - B. Fruit a woody capsule, dehiscent into 5 valves; flowers in racemes; ovary 5 celled.....*Alniphyllum*.

PTEROSTYRAX

Deciduous trees or shrubs. Leaves alternate, entire, dentate, pubescent, petioled. Flowers in panicles, fragrant; calyx 5 toothed; corolla 5 parted nearly to the base; stamens 10, exserted; ovary 3 celled; style long. Fruit a ribbed or winged nut, 1-2 seeded.

Three species in China and Japan. Referred by some botanists to *Halesia*.

***Pterostyrax micranthum* Siebold & Zuccarini.**

(*Pterostyrax hispidum* Siebold & Zuccarini.)

(*Halesia hispida* (S. & Z.) Masters.)

Tree sometimes 16 m. tall with gray-brown bark. Leaves without stipules, 6–21 cm. long, 3–10 cm. wide, elliptic or ovate to oblong, acute or acuminate, base cuneate, denticulate, green above, pale and glabrous or slightly tomentose below; petiole 1–2.5 cm. long. Panicles axillary, 10–16 cm. long with 2 or 3 leaves at the base of the inflorescence; flowers cream-white, fragrant, about 8 mm. long; ovary 3 celled; ovules 4 in each cell; style longer than the stamens. Fruit 1 cm. long, 2.5 mm. wide, tapered at both ends, 10 ribbed, densely hairy, crowned by the style.

China and Japan.

This plant is most often found under *Pterostyrax hispidum* in botanical literature but as *P. micranthum* refers to the same species and has prior place in the writings of Siebold and Zuccarini it should, by the rules of nomenclature, be regarded as the oldest botanical name.

***Pterostyrax corymbosum* Siebold & Zuccarini.**

Shrub or small tree. Leaves serrulate, usually with bristle pointed teeth, to 12 cm. long. Panicles corymbose, to 13 cm. long. Fruit with 4–5 narrow wings.

China and Japan. In China only known from Kuling, Kiangsi.

STYRAX

Shrubs or small trees, more or less stellate pubescent. Leaves deciduous or evergreen, alternate, stalked, without stipules. Flowers usually large, in drooping clusters; calyx campanulate, slightly 5 toothed, adnate to the base of the ovary; petals 5, slightly connate at the base; stamens 10 or fewer, inserted at the base of the corolla, free or monadelphous; ovary superior, 3 celled at the base; ovules several in each cell; style slender; stigma 3 parted or capitate. Fruit a drupe, globose or oblong, dry or fleshy, the pericarp dehiscent into 3 valves at the apex. Seeds 1–2, large, subglobose.

About 100 species in the warmer parts of Asia, Europe and America. About 12 species in China, most of them shrubs. From *Styrax benzoin* of the E. Indies, the fragrant resin benzoin is obtained.

Styrax japonicus Siebold & Zuccarini.

Shrub or tree up to 10 m. tall. Branchlets and leaves at first stellate pubescent. Leaves oval, tapering at both ends, sometimes acuminate, crenate serrate, dark glossy green, glabrous, 2.5–9 cm. long; petiole short. Flowers white, 2 cm. in diameter, pendulous, in a few flowered raceme; petals spreading, tomentose on the outside; calyx glabrous, with short teeth, persistent under the fruit. Drupe oval, about 12 mm. long.

Hupeh, Szechuan, Shantung to Korea and Japan.

ALNIPHYLLUM

Shrubs or trees. Leaves alternate, obscurely serrate, petiolate. Flowers perfect, white or red, in racemes; calyx campanulate, 5 toothed, tomentose; petals 5, connate at the base, oblong, elliptic, imbricate; stamens 10, unequal, in 2 series, the filaments united below into a tube; ovary partly inferior, 5 celled, ovate, tomentose; ovules 5–8 in each cell; style slender, terminated by an obscurely 5 toothed stigma. Fruit an oblong, woody capsule, dehiscent into 5 valves.

3 species, 2 in Formosa, 1 in China.

Alniphyllum fortunei (Hemsley) Perkins.

(*Halesia fortunei* Hemsley.)

Shrub or tree to 10 m. tall, or taller. Leaves ovate to broadly ovate, short acuminate, base rounded, remotely and regular or obscurely serrate, dark green above, paler and slightly tomentose below, 8–13 cm. long, 4.5–5.5 cm. wide; petiole 8–15 mm. long. Inflorescence many flowered, racemose or paniculate; flowers white, 2.5 cm. long; calyx 5 toothed, persistent; petals lanceolate-oblong. Capsule slightly 5 seeded, dehiscent into 5 lobes, dark brown, oblong, beaked, about 2 cm. long. Seeds numerous, irregularly winged, 6–10 mm. long.

Fukien, Yunnan and Hupeh.

OLEACEAE

Trees or shrubs. Leaves opposite, rarely alternate or whorled, simple or pinnate, without stipules. Flowers perfect or dioecious or polygamo-dioecious, regular, small; calyx 4 lobed (4-15); corolla 4 lobed (6-12), or rarely absent; stamens 2 (rarely 3-5); ovary superior, 2 celled; ovules 2. Fruit a drupe, berry, capsule, or samara.

Twenty genera and more than 400 species in the temperate and tropical regions. The Olive is the most important member of the family; others of horticultural interest are *Jasminum* (Jasmine), *Forsythia* (Golden Bell) and *Syringa* or Lilac. The following are the more important arborescent genera.

KEY TO GENERA

- I. Leaves pinnate; fruit a samara with a terminal wing. . *Fraxinus*.
- II. Leaves simple; fruit fleshy, a drupe or berry-like.
 - A. Fruit a 1-seeded drupe.
 - 1. Corolla deeply divided into 4 long linear lobes.....
..... *Chionanthus*.
 - 2. Corolla tubular *Osmanthus*.
 - B. Fruit berry-like, scarcely drupaceous, with 1-4 stones
..... *Ligustrum*.

FRAXINUS

Trees or shrubs. Terminal buds large, with 4 scales visible. Leaves deciduous, opposite, odd pinnate or rarely reduced to a single leaflet, petiolate and without stipules. Flowers regular, dioecious or polygamous or rarely perfect in terminal panicles on leafy shoots, or from axils of new leaves, or from buds developed from the axils of leaves of the previous year's growth, or from the base of young branchlets. Calyx 4 lobed or absent; corolla 4-6 parted or connate at the base in pairs. Stamens usually 2. Style 2 lobed. Ovary usually 2 celled; ovules 1 in each cell. Fruit a lanceolate or oblong-spatulate or flattened samara, 1 celled, 1 seeded.

About 30 species in the temperate regions of the N. Hemisphere. About 8 or 10 species in China. They are hardy as well as ornamental and are eminently suited for planting as street trees on account of their

pyramidal habit and light foliage. Most species are important forest trees as well, for they sprout freely from stump and produce a straight grained, tough, valuable wood of good size, much sought whenever pliability and toughness are the qualities desired. The wood is commonly used for making wagons, wheels, spokes, tool handles, furniture, and for interior finish.

***Fraxinus chinensis* Roxburgh.**

White Wax Tree. (Pe-la Shu).

A small tree, 13 m. tall with brownish-black winter buds which are conspicuously woolly tomentose at the time of opening. Branchlets glabrous. Leaves 13–20 cm. long, with channeled petioles enlarged at the base, nearly glabrous; leaflets 5–9, 5–10 cm. long, the basal pair smaller than the others, coriaceous, acuminate at the apex, rounded or cuneate at the base, serrate, short stalked, dark green and glabrous above, pubescent or hairy along the base of the veins and pale green below. Flowers with the leaves in lateral and terminal, glabrous panicles. Pistillate panicles 8–16 cm. long; calyx 4 parted; corolla absent. Fruit oblanceolate, obtuse, acute or emarginate at the apex, 4 cm. long.

Kiangsu, Chekiang, Anhwei, Szechuan, Hupeh, Kwangtung and Tongking.

This species is very variable as regards the shape and serration of the leaves. Five varieties have been distinguished. Among them is:

Var. ***rhynchophylla* Hemsley.**

Leaflets usually 5, entire or irregularly crenate-serrate, long acuminate, with slender stalks. Chihli and Manchuria.

***Fraxinus mariesii* Hooker.**

Shrub or small tree. Branchlets cylindrical, purplish, pubescent. Winter buds gray-black. Petiole glandular, pubescent. Leaflets 5–7, nearly touching each other, sessile, ovate to ovate-lanceolate, acute or acuminate, serrate or entire, puberulous along the base of the midrib, 4–8 cm. long. Flowers in erect, very showy panicles; calyx 4 cleft; petals 5 or 6; stamens 2–4. Fruit with a narrow obtuse wing.

Central China. This handsome species is very free blooming.



Plate 97. *FRAXINUS CHINENSIS* Roxburgh

1. Fruiting branch; 2. Flowering branch.

Insect white wax is produced on *Fraxinus chinensis* and *F. mariesii*. The insect, *Coccus pe-la*, is bred on the *Ligustrum lucidum* and other species of privet. In April, the mature cocoons are carried by night some distance to the region where the ash trees are cultivated and there affixed to the branches. In August, the branches incrustated with the wax are removed and boiled, the wax thus separated is melted and allowed to harden in pans. Pe-la is used for coating candles made from vegetable tallow and to a smaller extent from animal tallow, for coating pills and also for imparting a glossy surface to silks and better grades of cloth.

Fraxinus bungeana De Candole.

Tree 5 m. tall. Winter buds almost black. Leaflets 5, the basal pair only slightly smaller than the others, ovate or obovate, obtuse or short acuminate, serrate, glabrous, to 4 cm. long, distinctly stalked. Flowers in terminal panicles many flowered, to 6 cm. long; corolla divided nearly to the base; calyx with narrow acute lobes; filaments longer than the lobes of the corolla. Fruit linear-oblong, obtuse or emarginate at the apex of the wing.

N. China to Japan.

Fraxinus platypoda Oliver.

Tree 6 m. tall. Leaflets 7-9, 6-9 cm. long, ovate-lanceolate, slightly acuminate, serrate, pilose-tomentose on the midrib beneath. Base of leaf rachis dilated into an ovate or orbicular lobe. Samara 4.5-5 cm. long, ovate-oblong, with a slight mucronate apex; base surrounded by the persistent calyx.

Hupei.

F. paxiana also with the base of the leaf rachis dilated.

Fraxinus mandschurica Ruprecht.

Tree, 30 m. tall. Branchlet glabrous, quadrangular, with dark brown buds. Leaf rachis winged and brownish tomentose at the base of the leaflets; leaflets 7-13, 8-13 cm. long, oval or ovate-lanceolate, serrate, subsessile, pubescent on the veins beneath. Flowers appear before the leaves from axillary buds, dioecious, achlymedious (without calyx and corolla). Fruit in globose clusters, oblong-lanceolate, apiculate or emarginate, 2.5-4 cm. long.



Plate 98. *FRAXINUS PLATYPODA* Oliver

1. Fruiting branch; 2. Leaf

Manchuria, Korea and Japan.

The wood is used for railroad ties, agricultural implements, house construction, as well as for furniture and interior finish. Large quantities of this lumber, locally known as "Ma-li," are exported by the Japanese to this country.

Fraxinus griffithii Clarke.

(*F. bracteata* Hemsley).

Tree to 12 m. tall. Leaflets 5-7, coriaceous or subcoriaceous, entire or sometimes slightly crenate toward the apex, ovate-lanceolate or oblong, obtuse, with rounded or cuneate base, shiny green above, pale green and pubescent along the veins below, 5-10 cm. long; petiole of leaflets long and slender, curved. Panicles broad, dense, somewhat pubescent, 15-20 cm. high with oblong, persistent bracts. Petals 4; calyx cup-shaped, persistent. Fruit narrow spatulate, obtuse.

Central China, Himalayas, Japan.

Fraxinus retusa Champ.

Tree. Leaflets usually 5, glabrous, ovate to ovate-lanceolate, acuminate, serrate, prominently reticulated beneath, short petioled, 5-8 cm. long. Flowers white, many in a panicle; calyx cup-shaped, entire or obscurely 5 toothed; petals 4, linear-oblong. Fruit narrow, notched at the apex, about 2.5 cm. long and 3 mm. wide.

Fukien and Kwangtung.

Var. **henryana** Oliver.

Tree 11 m. tall. Leaflets oblong-lanceolate, serrulate, 7-12 cm. long, slender stalked. Panicles dense, 10-15 cm. long. Fruit 2-2.5 cm. long, emarginate.

Hupei and Szechuan.

Fraxinus paxiana Lingelsheim.

Tree to 13 m. tall. Leaflets 7-9, ovate, sessile with shallowly crenate margins, 10-17 cm. long. Fruits 2.5-3 cm. long.

Central China to Himalayas.

CHIONANTHUS

Shrub or tree. Leaves deciduous, opposite, entire. Flowers in loose panicles, white, fragrant, perfect or polygamous; calyx 4 lobed or

parted; corolla deeply divided into 4 (5 or 6) elongated lobes; stamens 2, rarely 4, inserted on the corolla; ovary superior, 2 celled; style short; stigma 2 lobed. Fruit a fleshy, ovoid, 1 seeded drupe.

Two species, 1 in N. America, the other in China. The American species, called the Fringe Tree, is a common garden plant cultivated especially for its abundant white flowers.

Chionanthus retusus Lindley & Paxton.

(*Chionanthus chinensis* Maximowicz.)

Chinese Fringe Tree.

Shrub or tree to 10 m. tall. Young shoots tomentose. Leaves obovate to oval or oblong-ovate, acute, rounded or emarginate at the apex, tapered at the base, deep shiny green above, pubescent along the veins below, 2.5-4 cm. long; petiole to 12 cm. long, densely pubescent. Flowers dioecious, snowy white, fragrant, in erect panicles opening in early summer; petals strap-shaped, to 2 cm. long. Drupe dark blue, ovoid, to 13 cm. long.

Hupeh, Szechuan, Yunnan, Kwangtung, Shensi, Shantung, Chihli, Korea, Japan, and Formosa.

The leaves of the seedlings and young plants of this tree are more or less finely toothed.

OSMANTHUS

Evergreen shrubs or trees. Leaves usually opposite, entire or toothed, short petioled. Flowers perfect, polygamous or dioecious, in axillary or terminal cymes or panicles; calyx 4 parted or toothed; corolla tubular with 4 elliptic, obtuse, imbricated lobes; stamens 2 (rarely 4) on the corolla tube; ovary 2 celled; style 2 lobed or nearly entire. Fruit an ovoid or globose drupe, with a 1 seeded stone.

About 8 species: Himalayas, China, Japan to North America.

Osmanthus fragrans (Thurb.) Louriero.

(*Olea fragrans* Thunberg.) Kwei Hua.

Shrub or tree to 10 m. tall. Leaves coriaceous, entire or serrate, reticulate beneath, elliptic to lanceolate, acute or acuminate, cuneate at the base, to 17 cm. long; petiole to 2 cm. long. Flowers white, very

fragrant; calyx 4 toothed; corolla divided nearly to the base, tube not over 5 mm. long, lobes oblong. · Drupe ovoid, about 12 mm. long.

Chihli, Szechuan, Yunnan, Hupeh. Extensively cultivated.

The leaves are usually serrulate on seedling and young plants, often becoming entire or nearly so as the plants reach flowering and fruiting condition. This is a favorite tree in Chinese gardens. The fragrant flowers are sometimes used to scent tea.

***Osmanthus armata* Diels.**

Shrub, or tree to 7 m. tall. Leaves short petioled, oblong-lanceolate, remotely spiny toothed or entire, cordate or rounded at the base, to 15 cm. long. Fruit dark violet, ovoid, 2 cm. long.

C. and W. China.

Osmanthus marginata Bentham and Hooker, *O. serrulata* Rehder, *O. venosa* Pampanini, are other species described as trees or shrubs in China.

LIGUSTRUM

Shrubs or trees. Leaves deciduous or evergreen, opposite, entire, short petioled, without stipules. Flowers perfect, white, in terminal panicles; calyx small, campanulate, obscurely 4 toothed; corolla tubular with 4 spreading lobes; stamens 2, inserted on the corolla tube. Fruit a 1-4 seeded drupe, berry-like, blue-black, greenish or yellow.

About 50 species. Several species are favorite hedge plants. They are much branched shrubs with paniced, white, fragrant flowers, and small berry-like fruits which are retained on the plant late in the winter.

***Ligustrum lucidum* Aiton.**

(Tung Ching.) Evergreen Privet.

Evergreen shrub or tree to 6 m. tall. Leaves ovate to ovate-lanceolate, pointed, tapering at the base, dark shiny green above, to 15 cm. long. Flowers white, in compact terminal panicles, 15-23 cm. long, and about as broad; corolla tube as long as the calyx. Fruit blue-black, to 12 mm. long.

Hupeh, Szechuan, Fukien, Chekiang.

Insect white wax is sometimes produced on this tree. A very attractive tree in winter with its dark green glossy foliage and abundant blue-black fruits. Very often planted in yards, over graves and along roadsides. *L. ibota* Siebold, *L. sinense* Lourieo and *L. amurense* Carriere are some of the most common shrubby forms in this country.

BORAGINACEAE

Herbs, rarely shrubs or trees, usually hispid. Leaves alternate, mostly entire, without stipules. Flowers perfect, regular, rarely irregular, usually pentamerous, in panicles, corymbs or racemes, rarely solitary; calyx persistent, free, 5 (4-8) cleft or lobed; corolla gamopetalous, 5 (4-6) lobed; stamens 5 or as many as, and alternating with, the lobes of the corolla; carpels 2, more or less united into an entire or 2-4 lobed ovary; cells 2; ovules 2 in each cell or cells 4, each 1 ovuled; style 1 (or 2); stigma usually 2. Fruit composed of 4, 1-seeded nutlets, the seed coat variously modified, or a drupe.

Eighty-five genera and about 1,500 species widely distributed. *Ehretia* is the only known arborescent genus in China.

EHRETIA

Shrub or trees. Leaves alternate, entire or dentate, with or without stiff hairs. Flowers perfect, pentamerous, small, white, in clusters or rarely solitary in the axils of the upper leaves; calyx persistent in the fruit; corolla rotate or cylindric with 5 narrow, rounded lobes; stamens on the corolla, exserted or rarely included; ovary at first 1 celled, later becoming imperfectly 4 celled by the development of 2 parietal placentae; ovules 2 in each cell; style 2 or bifid. Fruit a small drupe, 2 (1) celled, usually 4 seeded. The nutlets are bony and attached to a central column.

About 50 species, mostly in the tropics. Two species in China. The fruits are edible.

***Ehretia acuminata* R. Brown.**

(*Ehretia serrata* Roxburgh)

Tree up to 15 m. tall with gray bark longitudinally fissured. Leaves alternate, elliptic to oblong or acuminate, serrate, rounded at the base,

nearly glabrous beneath, 8-15 cm. long. Flowers clustered in terminal panicles or axillary with scattered, appressed hairs or glabrescent, small, sessile, white, fragrant; corolla deeply 5 lobed; style bifid. Drupe orange, turning to red or nearly black when ripe; nutlets 2, each 2 celled and 2 seeded.

Himalayas to China and Japan.

The wood of this and the following species is brown, with thick and lighter colored sapwood, even grained, light, tough, strong and easily worked. Carrying poles are often made from this wood. This tree is sometimes called the heliotrope tree from the odor of the flowers which resembles that of the heliotrope.

***Ehretia macrophylla* Wallich.**

Tree 8-15 m. tall, glabrous or pubescent. Bark pale gray, fissured. Leaves broadly elliptic or ovate-cordate, acute, serrate, bristly hairy above, silky hairy beneath, 15-25 cm. long. Flowers white, with ciliate calyx, very fragrant, in terminal pubescent panicles. Fruit globose, apiculate, obscurely 4 grooved, orange yellow, up to 1.5 cm. in diameter,

Himalayas to China. Kiangsi, Hupeh, Szechuan, Yunnan, Kwangtung, Hainan.

***Ehretia longiflora* Champion.**

Tree. Leaves elliptic or oblong, acuminate, entire, the veins few and scattered, glabrous, 6.5-10 cm. long. Flowers cymose, white or pink; calyx minute; corolla about 10 mm. long, with spreading ovate lobes; stamens exserted. Fruit globose, 6-8 mm. across, angular, grooved, and 4 parted at maturity.

Kwangtung.

SCROPHULARIACEAE

Trees, shrubs or herbs. Leaves alternate, opposite or whorled, simple, without stipules. Flowers perfect, more or less irregular. Calyx persistent, 4-5 parted or lobed. Corolla hypogynous, the petals united to form a bell shaped or 2 lobed limb; the upper lobe 2 parted, the lower 3 parted. Stamens as many as, or fewer than the parts of the corolla, usually 4, inserted on the corolla. Ovary superior, 2 celled; style single, rarely bifid; ovules numerous. Fruit a capsule, rarely a berry. Capsule 2 valved.

179 genera, about 2,500 species, distributed over the whole earth. They are extremely varied in habit, ranging from aquatic, or parasitic herbs to tall trees. Many genera are common garden plants, over 30 genera are cultivated for ornament in N. America. Several of the *Scrophulariaceae* are medicinal, the most important being *Digitalis purpurea*, a powerful poison, a narcotic, and a heart stimulant.

PAULOWNIA

Trees with chambered pith and pale gray, shallowly fissured bark. Leaves deciduous, rarely half evergreen, opposite, simple, entire or 3 lobed or coarsely toothed, long petioled, without stipules. Flowers in terminal, erect panicles, appearing before or with the leaves. Calyx 5 lobed, campanulate; corolla in a slightly curved tube, unequally 5 lobed at the apex. Stamens 4, included, attached to the corolla. Ovary superior, 2 celled; ovules numerous. Style 1. Fruit a 2-celled, woody or coriaceous, ovoid capsule, dehiscent loculicidally into 2 valves. Seeds minute, numerous, surrounded by a translucent, finely grooved or striated wing.

About 8 species in China. Introduced into cultivation in Europe, America, and Japan.

The Paulownias are extremely rapid growing trees with stout branches, large ornamental, white or purplish colored flowers, and woody or membranous, 2 valved capsules enclosing numerous small seeds with curious transparent striated wings which are very beautiful under the lens. The conspicuous, woolly tomentose buds impart a picturesque effect to the winter habit of the tree.

Paulownia tomentosa Koch.

(*P. imperialis* Siebold & Zuccarini.)

Tree 15 m. high. Leaves ovate, acuminate, cordate, entire or occasionally 3 lobed, 13–20 cm. long, dark green, pubescent above, gray-green, tomentose below; petiole 8–13 cm. long, tomentose. Panicles up to 28 cm. long. Flowers large, 4–5 cm. long, fragrant, violet colored, the lower lobes marked by dark spots and 2 yellow bands. Calyx and peduncles densely brown tomentose. Capsule ovate, pointed, about 4 cm. long. Seeds minute.

Native of Central and Western China.



Plate 99. PAULOWNIA TOMENTOSA Koch

1. Fruit; 2. Leaf; 3. Inflorescence; 4. Section of flower; 5. Seedling; 6, 7. Stamen; 8. Seed; 9. Section of fruit; 10. Section of corolla. (8 much enlarged.)

Planted as an ornamental tree. Very rapid growing. The wood was used in the olden days for the making of the lute. In Japan it is used for making sandals, boxes, and clogs. The more compact fine-grained specimens are esteemed for high grade furniture. The wood is also suitable for making charcoal for gunpowder.

***Paulownia fortunei* (Seeman) Hemsley.**

(*Campsis fortunei* Seeman.)

Tree 6 m. tall. Leaves subcoriaceous or membranous, ovate, or cordate to ovate-oblong, acute or acuminate, dark green and glabrous above, densely white tomentose beneath; petiole rounded, up to 12 cm. long. Flowers long and narrow, about 10 cm. long; calyx thick, glabrous, except the lobes; corolla with rounded lobes, white, spotted purple inside, oblique at the base. Fruit large, including calyx about 9 cm. long, woody, crustaceous (hard and brittle). Seeds numerous, about 6 mm. long,

E. and S. E. China. (Shantung and Kwangtung). Distinguished by the elongated leaves on long petioles, by the long narrow flowers, and the large, woody capsules.

***Paulownia duclouxii* Dode.**

Tree to 20 m. tall. Leaves ovate-oblong, tomentose beneath, to 30 cm. long. Flowers about 8 cm. long; corolla pale lavender, or white, not spotted, gradually tapering towards the base; calyx glabrous except the lobes, which are tomentose.

C. and S. W. China.

***Paulownia fargesii* Franchet.**

Tree to 20 m. tall. Branchlets shaggy hairy. Leaves entire or sparsely and coarsely serrate, pubescent on both surfaces or glandular above. Flowers about 6 cm. long, pale lavender or whitish, fragrant; calyx tomentose, the lobes acutish, triangular ovate.

W. China.

***Paulownia silvestrii* Pampanini and Bonat.**

Small tree. Leaves cordate, 8-13 cm. long, brownish tomentose beneath. Flowers pale blue in leafy panicles; calyx densely tomentose, with oblong obtuse scales.

C. China.

***Paulownia thyrsoidea* Rehder.**

Tree to 6 m. tall. Branchlets and petioles pilose. Leaves ovate, irregularly and sparsely serrate, usually truncate at the base, somewhat pubescent, 10–15 cm. long. Flowers with the leaves, lavender, 4 cm. long, in spike-like racemose panicles about 30 cm. long; calyx tomentose, about 8 mm. long.

Hupei and Fukien.

Other Chinese species are:—

***P. glabrata* Rehder.** (Shensi.)

***P. recurva* Rehder.** (W. Hupei.)

BIGNONIACEAE

Leaves usually opposite or whorled, compound or simple, without stipules. Flowers perfect, more or less irregular or bilabiate. Calyx 5 cleft, bilabiate or spathe-like; corolla of 5 lobes, gamopetalous, hypogynous. Stamens didynamous, or 2. Ovary superior, 2 celled, rarely 1 celled; ovules numerous; style 1; stigma 2. Fruit a capsule; seeds usually winged, exalbuminous.

100 genera and over 500 species. Many of them climbing plants, largely confined to the tropical countries, but a few extending into the temperate region.

Campsis chinensis—the trumpet vine, commonly cultivated in gardens, characterized by handsome orange or scarlet flowers, belongs to this family. *Catalpa* is the only arborescent genus in China.

CATALPA

Trees. Leaves deciduous, simple, opposite or in whorls of 3's, entire or lobed, pinnately veined, long petiolate, without stipules. Flowers perfect, in terminal panicles or corymbs. Calyx gamosepalous, splitting into 2 lobes when the flowers open. Corolla gamopetalous, campanulate, 2 lipped, the upper lip, 2 lobed, the lower 3 lobed with undulate margins, and variously marked and spotted on the inner surface. Fertile stamens 2, inserted at the base of the corolla, included. Ovary 2 celled, sessile; style filiform, 2 lobed at the apex, somewhat longer



Plate 100. *CATALPA OVATA* D. Don

1. Flowering branch; 2. Fruits; 3. Seed, enlarged.

than the stamens. Ovules many. Fruit a long, cylindrical capsule separating into 2 valves. Seeds numerous, with long tufted hairs at each end.

About 10 species; 2 in America, 3 in the West Indies, and about 5 in China. Except the W. Indian species all have been introduced into cultivation in Europe. The Catalpas are rapid growing ornamental trees characterized by large, bell-shaped flowers in panicles and long, slender pod-like capsules. They are suitable for street and lawn, and wood-lot planting. The wood is coarse and straight grained, soft but durable in contact with the soil, used for posts and railroad ties. The bark has a bitter property used in medicine as a tonic, diuretic and vermifuge. Propagated by seeds and cuttings. Comparatively free from insect and fungous attacks.

Catalpa ovata D. Don.

(*Catalpa kœmpferi* Siebold & Zuccarini.)

(*Catalpa henryi* Dode.)

Tree 8 m. tall, sometimes 15 m. tall. Leaves 12–23 cm. long and about as broad, ovate-cordate, short acuminate at the apex, rarely entire, usually 3–5 lobed, somewhat pubescent, with tufted hairs on the veins beneath, pale green, the nerves sometimes purplish; petioles with glands and glandular hairs, 5–15 cm. long. Inflorescence a much branched, many flowered panicle, 10–22 cm. long. Flowers fragrant; corolla creamy white marked with orange bands and purple spots, about 2.5 cm. long; calyx glabrous. Capsules 17–30 cm. long, 6 mm. in diameter, thin walled, splitting into 2 valves. Seeds 6–8 mm. long, grayish with long tufted hairs at each end.

Native of China, introduced into Japan by the Buddhist priests, cultivated in European gardens. The tree has fragrant, showy flowers and the leaves are without the disagreeable odor common to the other members of the genus.

Catalpa bungei C. A. Meyer.

Tree 12 m. tall. Leaves glabrous, acuminate, narrowly triangular-ovate, or deltoid-ovate, sometimes cuneate at the base, entire or with 1 to few lateral lobes or acute teeth at the base, purple spotted in the axils of the veins beneath, 8–16 cm. long, usually less than 8 cm. broad.

Inflorescence a compact, 3-12 flowered corymb; flowers white, spotted purple on the throat, up to 4 cm. long. Capsule 30-45 cm. long.

Chibli, Shantung, Shensi, Kweichow, and Yunnan. Common around Peking.

Catalpa fargesii Bureau.

Tree to 16 m. tall. Branchlets, leaves and inflorescence pubescent with branched hairs. Leaves ovate, acuminate, rounded at the base, entire, slightly pubescent above, more or less pubescent or densely yellowish tomentose beneath, 7-15 cm. long. Corymb 7-10 flowered, or more often fewer flowered in the lower branches. Flowers 3 cm. long, rosy-purple, with purplish-brown spots on the throat. Capsule 45-60 cm. long.

Western China.

Catalpa vestita Diels.

Closely allied to the above. The leaves and flowers are smaller. The under surface of the leaves is densely white tomentose.

May be only a form of *C. fargesii*.

Catalpa duclouxii Dode.

(*C. sutchuenensis* Dode.)

Tree to 25 m. tall. Parts glabrous. Leaves ovate, acuminate, usually rounded or subcordate at the base, with purple spots in the axils of the veins beneath, 13-20 cm. long, 10-13 cm. broad. Flowers rosy-pink with orange spots on the throat, 4-4.5 cm. long. Pods 60 cm. long.

Central China. Allied to *C. fargesii*.

RUBIACEAE

Trees, shrubs or herbs. Leaves simple, opposite or whorled, usually entire, with stipules. Flowers perfect, rarely unisexual, regular, rarely slightly unsymmetrical; calyx adnate to the ovary, 2-6 lobed, cut or toothed, or absent; corolla gamopetalous, 4-6 lobed, usually regular; stamens 4-6, inserted on the corolla and alternate with its lobes; ovary inferior, mostly 2 celled (1-many). Style simple or lobed. Fruit a capsule, drupe or berry. Seeds various, albumen fleshy or horny or absent.

About 240 genera and 4,500 species, mostly in the tropics.

Included under this family are the Coffee and Chincona trees. From the bark of the latter quinine is obtained. About 40 or 50 genera are under cultivation, among them *Gardenia* (with waxy, camelia-like flowers), *Cephalanthus*, a shrub, called the Button Bush on account of its fragrant flowers which are in globular heads, *Houstonia* and *Michelia* are common garden favorites.

KEY TO GENERA

- I. Flowers in corymbose panicles, the inflorescence with a white petaloid bract developed from the sepal of a flower persistent in the fruit *Emmenopterys*.
- II. Flowers in globose heads, solitary or arranged in panicles; inflorescences and fruit not accompanied by petaloid bract....
..... *Adina*.

ADINA

Trees or shrubs. Leaves petioled with large caducous stipules. Flowers in solitary or paniced globose heads. Calyx tube angular, 5 parted; corolla tubular, 5 lobed; stamens 5, inserted on the mouth of the corolla; ovary 2 celled; style filiform, with capitate stigma; ovules many in each cell. Fruit a capsule, dehiscent into 2 valves, many seeded. Seeds long, winged.

About 6 species in the tropics of Asia and America. At least 2 other species are found in China in addition to the following.

Adina cordifolia Hooker.

Tree. Leaves coriaceous, orbicular, acuminate, cordate, pubescent beneath, 10-13 cm. long. Inflorescence in a solitary head, about 2-3 cm. in diameter, on a stout peduncle 2.5-5 cm. long. Flowers yellow; corolla downy. Capsule cuneate, downy, about 4 mm. long, 6 seeded.

India to Yunnan.

Adina racemosa Miquel.

Tree to 15 m. tall. Leaves ovate to oblong, acuminate, shiny, glabrous. Inflorescence capitate. Fruit in racemes.

EMMENOPTERYS

Trees. Leaves deciduous, opposite, petiolate, ovate-elliptic, acuminate, cuneate, entire, somewhat coriaceous; stipules caducous. Inflorescence many flowered, corymbose, arranged in a terminal panicle. Flowers white; corolla bell shaped, 5 lobed, narrowed below into a cylindrical tube; calyx limb 5 lobed, ciliate, deciduous; stamens 5, included, inserted on the corolla; ovary 2 celled; style filiform; ovules numerous. A white leafy bract is appendaged to at least one flower in every corymb and persists on the fruit. Capsule woody, oblong-ovoid to cylindric, tapering at both ends, splitting partly into 2 valves; seeds numerous, minute, surrounded by a finely reticulated pithy wing.

Only one species known. The fruit is remarkable on account of the large wing-like petaloid bract attached to it. This appendage is developed from the bract of the flower.

Emmenopterys henryi Oliver.

Glabrous tree up to 26 m. tall and 1 m. in diameter, with scaly bark when young and rough gray bark at maturity. Leaves 10–16 cm. long, 5–11 cm. wide; petiole 2.5–5 cm. long. Bract to 5 cm. long. Corolla about 2.5 cm. wide. Fruit 2.5–5 cm. long.

Western China.

This tree is characterized by opposite, entire leaves, showy white flowers in corymbs of which one flower in every cluster is appendaged with a large, white leafy bract which turns pink as the fruit ripens. The fruit is an ellipsoid capsule splitting imperfectly into two valves liberating numerous small, imperfectly winged seeds.

This has been described as one of the most beautiful trees of the Chinese forests because of its large white flowers and white bracts which later turn pink and persist on the fruit.

TABLE OF MEASUREMENTS

1 meter = 10 decimeters

1 decimeter = 10 centimeters

1 centimeter = 10 millimeters

(Approximate English Equivalents)

1 m. = 3 ft. $3\frac{1}{3}$ in.

5 cm. = 2 in.

0.15 cm. = $\frac{1}{34}$ in.

1 cm. = $\frac{2}{5}$ in.

0.1 cm. = $\frac{1}{16}$ in.

1.2 cm. = $\frac{1}{2}$ in.

0.2 cm. = $\frac{1}{5}$ in.

1.5 cm. = $\frac{3}{5}$ in.

0.3 cm. = $\frac{1}{8}$ in.

1.8 cm. = $\frac{3}{4}$ in.

0.4 cm. = $\frac{1}{6}$ in.

2 cm. = $\frac{4}{5}$ in.

0.5 cm. = $\frac{1}{2}$ in.

2.5 cm. = 1 in.

0.6 cm. = $\frac{1}{4}$ in.

3.7 cm. = $1\frac{1}{2}$ in.

0.8 cm. = $\frac{1}{3}$ in.

4.4 cm. = $1\frac{3}{4}$ in.

GLOSSARY OF TECHNICAL TERMS

- A-*. Prefixed to a Greek word, without, e. g. *apetalous*, without petals.
- Abortive*. Imperfectly developed, or much reduced in size and efficiency.
- Accrescent*. Increasing in size with age.
- Achene* (akene). A small, hard, dry, 1 celled (1 seeded) indehiscent fruit.
- Acicular*. Needle-shaped; slender, stiff and pointed.
- Acuminate*. Gradually tapering to a point, the sides incurved.
- Acute*. Sharply and shortly pointed, the sides straight.
- Adnate*. Congenitally united. The subordinate one of two connate parts is said to be adnate to the other.
- Æstivation*. The arrangement of the parts of the flower in the bud.
- Aggregate*. A compound fruit developed from several carpels of one flower crowded in a mass.
- Albumen*. Food material stored within the seed surrounding the embryo.
- Alternate*. The arrangement of the leaves and other parts of a plant in a spiral, not opposite or whorled.
- Ament*. A catkin; a slender, dense spike of flowers, usually scaly and deciduous in one piece.
- Amphitropous*. Said of a straight and half inverted ovule with the hilum or scar on one side intermediate between the micropyle and chalaza.
- Anatropous*. Said of a straight ovule or seed that is inverted, with the micropyle next the hilum or scar, and the chalaza on the opposite side.
- Androgynous*. An inflorescence composed of both male and female flowers.
- Angiospermae*. Plants with the ovule in a closed ovary; seeds borne in a pericarp.
- Anther*. The part of the stamen which bears the pollen.
- Anthesis*. The time of the expansion of the flower.
- Apetalous*. Without petals.
- Apex*. The top or summit of an organ.
- Apiculate*. Ending in a short tip or point.
- Apophysis*. An enlargement or swelling on the surface of an organ.
- Appressed*. Pressed to the stem.
- Aril or arillus*. An extraneous seed coat or outer covering developed from the funicle of the seed, sometimes fleshy.

- Arillate.* Provided with an aril.
- Aristate.* Provided with awns or hair-like points.
- Armed.* Provided with thorns, spines, barbs or prickles.
- Articulate.* Jointed.
- Ascending.* Directed upwards.
- Auricled or auriculate.* Provided with an ear-shaped appendage or organ.
- Awn.* A bristle-like organ.
- Axil.* The angle on the upper side between the leaf and the stem.
- Axillary.* Borne in an axil.
- Axis.* The main or central line of a plant or an organ.
- Baccate.* Berry-like.
- Berry.* A fleshy, indehiscent, few to many seeded fruit.
- Bi-.* In a compound word meaning 2 or twice.
- Bipinnate.* Twice pinnate.
- Bladdery.* Inflated like a bladder.
- Blade.* The expanded or broad part of a leaf.
- Bloom.* The whitish waxy covering on some fruits, as in the plum.
- Bract.* The scale-like leaf associating with the inflorescence.
- Bracteate.* With bracts.
- Bracteolate.* With bractlets.
- Bractlet or Bracteole.* The bract of an ultimate flower stalk or pedicel.
- Branch.* A division of a stem or axis.
- Branchlet.* An ultimate division of a branch.
- Bristle.* A stiff, sharp hair.
- Bristly.* Provided with bristles.
- Bud.* An undeveloped branch or flower.
- Bud scales.* Reduced leaves covering a bud.
- Caducous.* Falling off very early.
- Calyx.* The flower cup or the outer perianth.
- Campanulate.* Bell-shaped.
- Campylotropous.* Said of an incurved ovule with the micropyle close to or next the base or chalaza.
- Canescent.* Having a grayish-white pubescence.
- Capitate.* Having a globular apex; said of flowers in a head-like cluster.
- Capsule.* A dry, dehiscent, 1-many seeded fruit formed of more than 1 carpel.

Carpel. A simple pistil or a unit of a compound pistil.

Catkin. An ament.

Caudate. Tailed or long-pointed.

Chalaza. The place where the kernel or body of the ovule is confluent with its coat.

Chartaceous. Having a papery texture.

Choripetalous. The petals distinct and free from each other.

Ciliate. Fringed with hairs.

Clavate. Club shaped.

Claw. The narrow or petiole-like base of some petals.

Cleft. Cut into lobes about half-way to the midrib (of a leaf.)

Coalescence. The union by growing together of similar organs, as stamens with stamens.

Coccus. (plural cocci) A division of a lobed fruit composed of 1-seeded cells.

Coherent. United together so slightly that the parts can be easily separated without tearing.

Conduplicate. Folded lengthwise, (in the bud.)

Cone. A fruit formed of imbricated scales.

Confluent. Joined together or blended.

Connate. United congenitally, so closely that they cannot be separated without tearing.

Connective. The portion of a stamen by which the two cells of the anthers are joined together.

Contorted. Twisted.

Convergent. When the parts are closer together at the apex than at the base.

Convolute. Rolled up from the sides lengthwise.

Cordate. Heart-shaped.

Coriaceous. Leathery in texture.

Corolla. The second set of the floral organs composed of the petals.

Corymb. A flat-topped or convex, open, compound flower cluster, the pedicels of different lengths and the outer flowers opening first.

Corymbose. In corymbs.

Cotyledons. The primary leaves of the embryo.

Crenate. Scalloped edged, with rounded lobes.

Crenulate. Minutely crenate.

Crustaceous. Hard and brittle in texture.

- Cuneate.* Wedge-shaped, triangular in section or outline.
- Cuspidate.* Tipped with a sharp stiff point.
- Cyme.* A flat-topped or convex inflorescence. The flowers opening from the center outwards.
- Cymose.* Cyme-like or furnished with cymes.
- Deciduous.* Falling off.
- Decomound.* Several times compounded or divided.
- Decurrent.* Running down, as the blades of a leaf extending down the petiole, or the petiole of a leaf extending down the stem beyond the point of insertion.
- Decussate.* In alternating pairs at right angles to each other.
- Dehiscence.* The opening of an anther or capsule by valves or slits.
- Deltoïd.* Of a triangular shape, the apex uppermost.
- Dentate.* Toothed.
- Denticulate.* Minutely toothed.
- Di-.* In a compound word signifies two or twice.
- Diadelphous.* Stamens united by their filaments in two sets.
- Didynamous.* With 4 stamens in 2 pairs of different lengths.
- Dichotomous.* Forking regularly in twos.
- Digitate.* Said of a compound leaf in which the leaflets are all borne on the apex of the petiole, after the manner of the fingers of the hand.
- Dimorphous.* Of two forms.
- Dioecious.* Male and female flowers on different plants.
- Disk.* An enlargement or prolongation of the receptacle of the flower around the base of the pistil.
- Distichous.* Two ranked.
- Distinct.* Free, not united.
- Divergent.* When the parts are farther apart at the apex than at the base.
- Divided.* Cut into divisions or lobes down to the base or midrib.
- Dorsal.* Relating to the back.
- Downy.* Covered with soft, short hairs.
- Drupaceous.* Drupe-like.
- Drupe.* A stone fruit with soft, fleshy or fibrous seed coat surrounding a hard bony seed.
- Eccentric.* Not central; one sided.
- Echinate.* Armed with spines.

Ellipsoid. An elliptic solid—in longitudinal section, an ellipse; in cross-section, a circle.

Elliptic. Oval or oblong with rounded ends.

Emarginate. Notched at the apex.

Endemic. Native of a country.

Endocarp. The inner layer of a pericarp or fruit.

Endosperm. The substance surrounding the ovule.

Epicarp. The thin, filmy external layer of a pericarp; the outermost layer of a fruit.

Epigynous. Placed on the ovary.

Exalbuminous. Without albumen.

Excurrent. Projecting beyond the apex.

Exserted. Protruding, as the stamens beyond the floral envelope.

Exstipulate. Without stipules.

Extrorse. Facing outward; the anther directed away from the axis of the flower.

Falcate. Scythe-shaped; curved, with parallel sides.

Fascicle. A close cluster.

Fascicled. Growing in a bundle or tuft.

Fertile. Capable of bearing fruit.

Filament. The stalk of the stamen, or any thread-like body.

Filiform. Thread-like; long, slender, and cylindrical.

Fimbriate. Fringed.

Foliaceous. Leaf-like.

Foliate. Having leaves.

Foliolate. Bearing leaflets.

Follicle. A pod opening by the inner suture.

Follicular. Similar to a follicle.

Fugacious. Lasting only a short time.

Fulvous. Tawny colored.

Furcate. Forked; two or three or more branched.

Furrowed. Grooved or channelled.

Fuscous. Deep gray-brown.

Fusiform. Spindle shaped; a cylindrical body, tapering at both ends.

Funicle. The stalk of an ovule or seed.

Gamopetalous. Of united petals.

Gamosepalous. Of united sepals.

- Glabrate.* Becoming glabrous or nearly glabrous with age.
- Glabrous.* Without hairs, or not pubescent.
- Gland.* A protruding body which secretes oily or aromatic substances; more often being understood in the sense of gland-like, whether it secretes or not.
- Glandular.* Provided with glands; or gland-like.
- Glaucouscent.* Slightly glaucous or bluish-gray.
- Glaucous.* Covered with a white bloom of a waxy substance which rubs off.
- Globose.* Nearly spherical.
- Gymnospermæ.* Plants with naked seeds.
- Gynæcium.* The pistils as a whole.
- Gynandrous.* The stamens united with the pistils.
- Habitat.* The place in which a plant grows.
- Hermaphrodite.* A perfect flower; one having both stamens and pistils.
- Hetero-.* In Greek compounds, meaning of two or more sorts, as heterophyllous—with two sorts of leaves.
- Hilum.* The scar of a seed, the place of its attachment.
- Hirsute.* Hairy, with coarse, stiff hairs.
- Hispid.* Bristly, provided with stiff hairs.
- Hypogynous.* Free from or inserted under the pistil.
- Imbricate.* Overlapping one another, as the scales of a fish.
- Induplicate.* With edges folded or turned in.
- Imperfect.* Flowers without either stamens or pistils.
- Incised.* Deeply and irregularly cut.
- Included.* Not exerted; enclosed.
- Incomplete.* Said of a flower in which either calyx or corolla is wanting.
- Indefinite.* Very numerous, or not uniform in number.
- Indehiscent.* Not splitting open.
- Indigenous.* Native, not introduced.
- Inferior.* Said of an organ placed beneath another; an ovary is inferior when the floral organs grow on its summit.
- Inflated.* Bladder like.
- Inflorescence.* Flower-cluster, or the arrangement of the flowers in a plant.
- Internode.* The space between two nodes of a stem.
- Introrse.* Facing inward.
- Involute.* A whorl of bracts subtending a flower or a flower-cluster.
- Irregular.* Not symmetrical.

Keel. A projecting ridge like the keel in the bottom of a boat; the keel-like petals of a papilionaceous flower.

Laciniate. Cut into narrow lobes or segments.

Lanate. Woolly, clothed with long and short tangled hairs.

Lanceolate. Lance-shaped, long and narrow and tapering at least at the upper end.

Leaflet. A division or one of the blades of a compound leaf.

Lateral. Belonging to the side, as opposed to terminal.

Legume. A pod composed of a single carpel, dehiscent along both sutures.

Lepidote. Covered with small scales.

Ligulate. Strap-shaped.

Linear. Said of a narrow leaf, several times longer than broad, with the margins parallel.

Loculicidal. A capsule dehiscent on the dorsal suture, or the back of each cell.

Micropyle. Same as foramen; an opening in the coats above the apex of the ovule or seed.

Membranaceous. Membrane like, thin and soft in texture.

Merous. Part, as trimerous, of three parts.

Mono-. In Greek compounds, meaning one, as monocotyledonous—having one cotyledon.

Monodelphous. In one brotherhood or set.

Monœcious. Male and female flowers borne on the same plant.

Mucronate. Abruptly tipped with a short point.

Naked. With no floral or other envelopes.

Nectariferous. Having a nectary; honey-bearing.

Nerve. A vein of the leaf.

Netted. With branching veins forming a fine net-work.

Nut. A hard, indehiscent, one seeded fruit, produced by a compound ovary.

Nutlet. A little nut or stone.

Ob-. When prefixed to a word, meaning inverted.

Obconical. Inverted top-shaped.

Obcordate. Inverted heart-shaped.

- Oblanceolate.* Inverted lance-shaped.
- Oblique.* Unequal, one sided, or slanting.
- Oblong.* From two to four times longer than broad.
- Obovate.* Inverted ovate, the broad end uppermost.
- Obtuse.* With a rounded end.
- Opposite.* Leaves or branches in pairs at the same height but on opposite sides of a stem.
- Orbicular.* Circular in outline.
- Orthotropous.* Said of a straight ovule, the chalaza at the base and the micropyle at the apex.
- Ovary.* The ovule-bearing part of the pistil.
- Ovule.* The part of the flower which, when fertilized, becomes the seed
- Palmate.* Lobed or divided into a palm-like fashion, or like the fingers of a hand.
- Panicle.* An open and branched inflorescence.
- Paniculate.* As a panicle, or panicle-like.
- Papilionaceous.* Butterfly like; an irregular flower of the pea family.
- Papillate.* Covered with small protuberances.
- Parietal.* Attached to the walls of the ovary or fruit.
- Pedicel.* The stalk of a single flower.
- Peduncle.* Stem of a flower or flower cluster.
- Pellucid.* Transparent.
- Peltate.* Shield-shaped.
- Pendulous.* Hanging or drooping.
- Penicillate.* Tufted like a brush.
- Penta-.* In Greek words meaning five.
- Perfect.* Flowers having both stamens and pistils.
- Perianth.* The floral envelope taken as a whole; commonly applied to flowers in which calyx and corolla cannot be distinguished.
- Pericarp.* The ripened ovary; the wall of the fruit.
- Perigynous.* Stamens borne on the perianth around the ovary.
- Persistent.* Attached, not falling after the growing period.
- Petal.* A unit or part (a leaf) of the corolla.
- Petaloid.* Resembling or colored like the petal.
- Petiole.* The stalk of a leaf.
- Petiolule.* The stalk of a leaflet.
- Pilose.* Clothed with soft, distinct, slender hairs.

Pinna (plural *pinnae*). The primary division of a bipinnate leaf.

Pinnate. A compound leaf whose leaflets are arranged on the sides of a common petiole.

Pinnule. A secondary division of a bi- or tri- pinnate leaf.

Pistil. The female organ of the flower, composed of the ovary, ovule, stigma and style; the seed-bearing organ.

Pistillate. Having a pistil.

Placenta. The part of the ovary to which the ovules are attached.

Pod. The fruit of a legume.

Pollen. The powdery contents of the anthers; the fertilizing element.

Poly-. In a Greek compound, meaning many.

Polyandrous. Having numerous stamens.

Polygamo-dioecious. Said of flowers sometimes perfect, sometimes unisexual, the two forms borne on the different plants.

Polygamous. Having some flowers perfect, some unisexual.

Polygamo-monoecious. Said of flowers sometimes perfect, sometimes unisexual, the two forms borne on the same plant.

Polymorphous. Of several forms.

Polypetalous. Corolla of separate petals.

Pome. The fruit of the pear or apple, and the like, in which the calyx ripens fleshy, and the carpels into membranous cells enclosing the seeds.

Proteranderous. Said of a flower whose anthers shed their pollen before the stigmas become receptive, a device insuring against self-pollination.

Puberulent. Covered with fine, short, almost imperceptible hairs.

Pubescent. Hairy or downy; with fine soft hairs or pubescence.

Pulvinate. Cushion shaped.

Punctate. Minutely dotted.

Pyriform. Pear-shaped.

Quadri-. In Latin words, meaning four.

Raceme. A flower cluster, composed of individual flowers on pedicels of equal length, attached to a common peduncle.

Racemose. In racemes or raceme-like.

Rachis. The axis of an inflorescence or of a compound leaf; the common petiole on which the leaflets of a compound leaf are borne.

- Radiate.* Spreading from a common center.
- Receptacle.* The axis of a flower bearing the floral organs, or the common axis or support of a flower cluster.
- Reflexed.* Directed backwards or outwards.
- Regular.* Said of all parts equal in shape or size.
- Reticulated.* Netted, said of veins when they are arranged in a net-work fashion.
- Retorse.* Directed backward or downward.
- Retuse.* The apex rounded and slightly indented.
- Revolute.* Rolled backward.
- Rhachis.* Same as rachis.
- Rostrate.* Beaked.
- Rudimentary.* Imperfectly developed.
- Rugose.* Wrinkled.
- Sagittate.* Shaped like the head of an arrow.
- Samara.* An indehiscent winged fruit; for example, the key fruit of the maple.
- Scabrous.* Rough and coarse to the touch.
- Scaly.* Furnished with scales or scale-like.
- Seed.* The fertilized and mature ovule.
- Semi-.* In a Latin compound, meaning half.
- Sepal.* A division or leaf of the calyx.
- Sepaloid.* Sepal-like.
- Septate.* Divided by a partition.
- Septicidal.* Splitting open through the partitions.
- Septum.* A partition.
- Seriate.* In rows.
- Sericeous.* Silky.
- Serrate.* The margin beset with teeth pointing forward.
- Serrulate.* Serrate with fine teeth.
- Sessile.* Without a stalk.
- Setose.* Beset with bristles.
- Setulose.* Provided with minute bristles.
- Shrub.* A woody plant not over five m. high, and usually dividing into several small stems at the ground.
- Simple.* Of one piece, in contrast to compound.
- Sinuate.* Wavy margined.

- Sinus.* A recess between the lobes.
- Spathe.* The bract or leaf which surrounds or subtends an inflorescence.
- Spatulate.* Shaped like a spatula, with a spoon-like outline.
- Spicate.* Resembling a spike.
- Spike.* A flower cluster similar to a raceme but with the flowers sessile.
- Spine.* A thorn.
- Spinescent.* Ending in a thorn or spine.
- Stamen.* The male organ of a flower, composed of the filament and anther.
- Staminate.* Furnished with stamens.
- Standard.* The upper large petal of a papilionaceous flower.
- Stellate.* Star-shaped.
- Sterile.* Barren or infertile.
- Stigma.* The part of the pistil which receives the pollen for fecundation.
- Stigmatic.* Belonging to the stigma.
- Stipe.* A stalk-like support.
- Stipel.* A stipule of a leaflet.
- Stipitate.* Furnished with a stipe.
- Stipules.* The appendages of a leaf at the base of the insertion of the petiole.
- Striate.* Marked with slender, shallow, longitudinal grooves or fissures.
- Stomata.* Breathing pores in the epidermis of a leaf.
- Stomatiferous.* Bearing stomata.
- Stone.* The hard endocarp of a drupe.
- Strobile.* A cone.
- Style.* The stalk of the pistil between the stigma and the ovary.
- Sub-* A prefix, meaning slightly, somewhat.
- Subulate.* Awl-shaped; tapering from a thickish base to a point.
- Succulent.* Juicy.
- Sulcate.* Grooved, with deep furrows.
- Superior.* Growing or placed above, said of an ovary when the floral organs are inserted below it.
- Suture.* A line of junction, usually the place of dehiscence of a carpel.
- Sympetalous.* A corolla of united petals.
- Syncarp.* A multiple fruit formed by the union of several carpels.
- Tawny.* Dull yellowish-brown tinged.
- Tegmen.* The inner coat of a seed.
- Terete.* Round and long.

Terminal. Borne at or near the extremity, or summit.

Ternate. In threes.

Testa. The outer seed coat.

Tomentose. Densely clothed with matted wool.

Torus. The receptacle of a flower.

Tree. A woody plant usually more than five m. tall with a distinct trunk or main axis.

Tri-. Prefix, meaning three.

Trifid. Three cleft.

Trifoliate. Of three leaflets.

Truncate. Cut off at the end or top.

Tubercle. A small tuber or excrescence.

Tuberculate. With knobby excrescences.

Tubular. Hollow, cylindrical or elongated in form.

Turbinate. Obconical or inverted top-shaped.

Valve. One of the parts of a dehiscent pod.

Valvate. (In æstivation) The arrangement of sepals or petals in the bud in which the edges touch but do not overlap.

Ventral. The lower or inner side of an organ.

Versatile. Attached by one point, enabling it to swing in several directions.

Villose. With long, shaggy soft hairs.

Viscid. Sticky.

Volute. Rolled up in any manner.

Wavy. The surface or margin alternatingly convex and concave.

Whorled. The arrangement of branches or leaves in circles around the stem or axis.

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<i>Tilia intonsa</i>	247	<i>Zelkova hirta</i>	118
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